ENGINEERING AND
MINING JOURNAL-PRESS

JOSIAH EDWARD SPURR, Editor

Volume 121 | New York, April 24, 1926 | *Number* 17

The Selenium Supply Problem

SELENIUM, which is a metal closely allied to tellurium, is placed by chemists, in its order of abundance in the earth, as 40th out of a total of 44, coming in this respect between bismuth, which is 39, and gold, which is 41. The still rarer elements listed in this classification are, in the order named, bromine, tellurium, and platinum. Price, of course, is not controlled solely by relative scarcity, but is determined by demand, or usefulness, in connection with scarcity. Thus bismuth sells around $3 a pound, selenium around $2 per pound, gold around $250 per pound, tellurium around $2 per pound, and platinum around $1,300 per pound. The price tells the story: bismuth, selenium, and tellurium have found restricted uses and are in small demand.

The production of selenium and tellurium began between 1905 and 1910. The selenium production in the United States for 1910 was a little over 10,000 lb., while between 1918 and 1923 the output fluctuated between 60,000 lb. and 123,000 lb. annually. The production in 1924 was around 130,000 lb., and 1925 production probably did not exceed that figure; in 1925, according to H. C. Meyer, in the Annual Review Number of *Engineering and Mining Journal-Press*, there appeared to be an overproduction. The United States appears to be by far the largest producer; some comes in from Mexico and a certain amount is produced in Europe.

Until recently the chief use of selenium has been as a decolorizer in the glass industry—the addition of selenium to the molten-glass magma offsets the green color due to iron. The average annual consumption in this country, plus part of the European consumption, has been estimated by F. F. Colcord at 79,000 lb.

Very recently a new use has been discovered for selenium—in the process of vulcanizing rubber. It is claimed—and apparently conservatively—that selenium thus used increases the toughness or wear-resisting qualities of a rubber compound 50 per cent. Rubber so treated is actually being marketed as rubber sheathing for wire cables, and this use is estimated to require 15,000 to 20,000 lb. a year. The success of this trial leads naturally to the thought that rubber used for other purposes, such as automobile tires, could be advantageously so treated. If this could be done, the area of rubber plantations in the world could be reduced greatly; and one phase of the overadvertised problem of the rubber supply would be solved. The question is: can the world produce selenium for what appears to be an imminent demand? It is estimated that if this process were used on all automobile tires in the United States it would consume 2,000,000 lb. of selenium yearly for this use alone, or twenty times the present production. As to the possibility of supplying it, the evidence of the geochemist, above cited, would be unfavorable. This would also be the impression of the geologist from his general knowledge. Selenium mines, as such, of course are unknown—the metal (like tellurium and other metals) is a byproduct: of sulphuric acid manufacturing from pyrite and from copper refining. There remains the question as to how much additional supply an increased price would bring out, assuming that the new use would warrant a much higher price than the present one—concerning which we have no information. The present annual world production of gold, which is placed by the chemists next to selenium in the scale of rarity, is around 1,600,000 lb., at the current figure of roughly $250 a lb.; and apparently this is about the world's capacity at that price. A certain increased price for selenium would doubtless bring about a larger supply, but it appears unlikely that the amount which may be required by industry can be obtained at a feasible figure, if indeed it can be obtained at all.

Nevertheless, there are possible surprises in the mineral world: and we desire to call the attention of our world readers to this situation, and to ask them to advise us of any considerable as yet undeveloped source of selenium ores. We will publish such information for the benefit of the industry in question, which has applied to *E. & M. J.-P.* to send out this S O S.

The International Mining Industry

A PROMINENT AMERICAN MANUFACTURER of mining machinery is reported to have stated that during the last few years from 49 to 52 per cent of his business has been export business. Undoubtedly, as we have often pointed out editorially, mining must henceforward be visualized as an international affair. The foreign subscribers to *Engineering and Mining Journal-Press* have increased without solicitation till they now number about one-third of the whole. The world will be none too large, in the future, for the mining industry; and operator, metal seller and buyer, and equipment manufacturer alike must consider their industry and their business in this light. Export business from the United States is only one side of the problem; the problem is one of imports also into the United States; and, in a still bigger way, of international trades in metals and mining machinery and in capital: such as the trade of Germany with Mexico, of England with Japan, of Belgium and Africa.

Modern Literature and Inventions

ACCORDING TO THE OBSERVATIONS of Dr. Richard Mooreleigh, only two newspapers in New York are fit to bring into the family. The rest he said are all worse, and some far worse, than the pink *Police Gazettes* that we used to glance at furtively in barber shops when we were boys. He agrees also with the recent article of Mr. Villard in the *Atlantic Monthly*, that the greater proportion of magazines

vended on the newsstands are harmful rather than elevating. He observes, further, that having sojourned recently at a winter-resort hotel where there was a great deal of leisure and reading done, he saw nothing in process of being read but the most ephemeral of current fiction. He doubts whether printing has been a blessing: the chief uses seem to him to be the pandering to the lowest of the lowly, preventing them from rising, and also hampering many who have a chance to rise.

That other great publicity device, the movies, he says, follows the same line. Rarely does he find a movie fit to see; they specialize on elemental passions and make no pretense of education. The telegraph he says is largely used in disseminating misinformation; the automobile has made the crime wave possible, and is otherwise chiefly used in rushing people from place to place when they might better have stayed where they were. Mechanical inventions, in short, he believes have not improved the human race nor accelerated that evolution which is its goal; nor have they increased the joy of living, the present compensation for inevitable terrestrial hardships, handicaps, and penalties.

Interrogated as to the technical press, he observed that it had a chance to rise superior to the newspapers and most of the popular magazines, establish for itself the record and fact of a higher educational and even literary plane, and join the "quality" ranks of publications: nevertheless, he sees little chance of its doing so. The technical press, he says, is more accurate, but more narrow: too often it is regarded by the publisher as simply a vehicle to sell machinery for the manufacturer, so that he may be conciliated to expand his advertising contracts. There is no hope in a technical literature that is simply a part of manufacturers' selling campaigns, he intimates. He acknowledges there are groups and individuals among the technical press which are exceptions, and whose editorial subject-matter and policies may be regarded as unbiased and as helpful; but even these, he believes, are hardly inspirational.

If Dr. Mooreleigh will compare conditions in the world four hundred years ago with those today, he must observe that the world is indeed advancing, that the general intelligence and equity has risen, and that life has become far more worth living. The vast increase of schools and universities is one of the best proofs of popular mental expansion; and his own university chair would probably have been impossible in the pre-mechanical invention days which he is inclined to compare favorably with the present.

Elusive Gold

MORE GOLD is to be found in seven counties of Virginia than in the whole State of California, says the prospectus of the Evans Ore Reduction Co., which claims to have a process of finding the precious metal in Southern gold ores in larger quantities than any one else has succeeded in doing. That is, the prospectus says that an experienced mining chemist once said so. The company is to be congratulated on its ability to recover this gold, "which," it says, "is locked up in a compound of metals and, being in a fine flour state, escapes with the fumes when heat is applied," to quote from its literature. There is something peculiar about this fine flour gold that is so elusive that even skilled metallurgists and assayers fail to find it, though they are versed in the latest developments of physics and chemistry and are equipped with 1926 model apparatus. The Evans process applies to the whole field of the South, the company states, the ore being of no value without it. Unfortunately, the writer of the prospectus takes it for granted that everyone is as well posted as he is regarding this new advance in applied science. "It is unnecessary to give full details of the process," he says, "which is unlike anything heretofore attempted; it separates the metals in a furnace of special design, by chemical gases; the fumes and volatile metals being forced into condensers, while the gold and silver remain behind free and easily recovered by cyanide."

To return to the first statement, that more gold is to be found in seven counties of Virginia than in all California, it is not at all unreasonable to go a step further and assert that if the process can produce more gold than assayers and metallurgists have hitherto been able to detect, perhaps there is in Virginia more gold than in Porcupine, Kirkland Lake, the Rand, the Kolar field and all the rest of the world combined. Perhaps!

Senator Cameron Blows Off

SENATOR RALPH H. CAMERON, of Arizona, illuminates the April 9 issue of the *Congressional Record* with an extended appeal for a tariff on copper, a part of his address being reprinted in the last issue of the *E. & M. J.-P.* Careful reading of the Senator's complete speech cannot but impress one with the speciousness of his arguments. He dwells at length on the immense deposits of copper in Africa and South America, pointing out their alleged low cost of production as against the high cost of getting copper from the comparatively limited and low-grade deposits of the United States, where steam-shovel mining, one gathers, is practically unknown. The Chilean producer, he says, can deliver his copper in New York at an average cost price of 6c. per pound. If he refers to the Chile Copper Co., the actual cost was 8c. per pound, not including depletion, according to the latest annual report available, that for 1924. Katanga, he avers, should soon be able to deliver its copper in New York at a cost of 4.8c. per pound. This will certainly be quite a reduction from the actual cost, which he gives for 1924, which was 10.4c. per pound. "It is evident," he says, "that Katanga copper can be laid down in New York at less transportation cost than our domestic copper." Here, again, he must have vast economies in mind, for at present it costs something like 3c. per pound to get Katanga copper from the smelter to the New York refinery. The cheap native labor of course receives attention. It would hardly be fair to readers of this journal to keep the following passage from them:

> "There are millions of Belgian Kongo negroes available at wages that will not exceed 20c. per day. The Kongo, with its reeking and soul-harrowing memories of enslaved labor, its jungle trails paved with countless sighing souls and trodden by the millions of forced tribute bearers of ivory and rubber in the past, are now to be used to gather copper for export to our domestic market.
>
> "One can visualize the malachite green and azurite blue of the Katanga ore shot through with the cuprite red from the straining, sweating, and soul-racked bodies of impressed labor. On the one hand we can see the few palatial continental mansions of the masters and the countless African huts housing their downtrodden labor. In contrast thereto can be seen the hundreds of copper districts within our homeland, peopled by hundreds of thousands of our kin, in

comfortable homes and midst surroundings and opportunities befitting our advanced civilization."

Later on, Senator Cameron fears that "two closely related domestic corporations," meaning, probably, Anaconda and Guggenheim Bros., controlling 53 per cent of the United States production and all of the Chilean production, will dominate the world and close down the United States high-cost mines, and produce a maximum quantity to fill world wants from Chile. "There may exist," he says, "a possible corporate ambition within these two corporations that after merging their equities, thereby directly controlling 85 per cent of the known copper reserves of the world, they will be able to dictate the price of copper. . . . The domestic copper miner views with alarm the power these dual controllers possess.

"The continued importation of cheap foreign-labor copper will destroy our domestic milling, leaching, and copper-smelting industries; . . . likewise many communities will be utterly destroyed." It is strange that no such effects are beginning to be noted; copper production from United States mines has been steadily gaining since 1921; present production is way beyond the pre-war level, and is not far behind the wartime peak.

The Senator is clever in the choice of some of his statistics. "In 1913," he says, "we produced 1,224,500,000 lb. of copper; our domestic consumption was 812,000,000 lb., or 67 per cent thereof. This left 412,000,000 lb. of domestic copper, or 33 per cent, available for export. In 1923 we produced 1,435,000,000 lb. of copper; our domestic consumption was 1,300,000,000 lb., or 93 per cent thereof. This left 135,000,000 lb. of domestic copper, or 7 per cent, available for export."

So far, so good; but in 1924 the exportable surplus of the United States was much higher, being slightly over 400,000,000 lb., and in 1925 it was more than 500,000,000 lb., or well over what it was in 1913. Here, after all, is the essential fact. Admitting all that the Senator says is true, his remedy for the situation, a protective tariff, will be futile so long as domestic copper producers find it profitable to mine more copper than the country needs. Secure a copper tariff if you can, Senator; it will do no harm, and the producers perhaps deserve help more than the lead producers do, for example, who have one. But don't fool the copper miners into thinking that it is going to help them any under present conditions.

The Pike Process and Copper Concentrate Treatment

EXPERIMENTAL DEVELOPMENT of a method of copper concentrate treatment by the Engels Copper Mining Co. is of considerable interest to all copper producers and reflects credit upon the California company for its initiative. The Pike process, as the method is called, involves electro-hydrometallurgical operations that have been advanced through the pilot-plant stage at a cost of $111,685.

The Engels company produced 27,355 tons of concentrates in 1925, which cost in freight charges to the smelter $221,490 and in smelter charges and deductions $507,785, or a total of $729,275. Marketing cost of these concentrates was $26.65 per ton, or 4.8c. per pound of copper, not including credit for gold and silver, and the total marketing expense was 31.9 per cent of the gross metal value and 41.3 per cent of the total costs of operation and concentrate treatment. Freight to the smelter costs about 1.5c. and smelting charges about 3.3c. per pound of copper without including gold and silver credits. These data bring out clearly one of the major difficulties that attend an enterprise dependent upon marketing concentrates through normal channels.

Apparently the only hope for improvement lies in hydrometallurgical treatment of the concentrate, and in this field the Engels investigation appears to be the most complete of any so far made. Estimates of probable operating cost have been worked out and indicate a cost of 4.5c. per pound of copper, including eastern delivery charges and also the production of 1.2 lb. of electrolytic iron as a byproduct. Plant cost is estimated at about $240 per annual ton of copper. The costs have been estimated for Pacific Coast conditions. A comparison with costs of freight and smelter treatment indicates only a small margin in favor of hydrometallurgical treatment without consideration of byproducts. However, the incidental production of a pure electrolytic iron indicates an important advantage of the hydrometallurgical method. Utilization of the iron and part of the sulphur is now apparently attainable at reasonable cost.

Geological Consistency and Sampling of Low-Grade Deposits

A SHORT TIME AGO our attention was called to what is claimed to be a large low-grade silver-gold deposit. Apparently the formation is consistent and of like kind over a considerable area and to a depth of some 600 ft. Prospecting openings at different points are all said to be in "ore," and samples of the outcrop apparently bear out the assumption of low-grade material over a wide area. One raise, one crosscut, and about 6,000 ft. of drifts comprise the principal workings, but these were planned during initial exploration and are not systematically distributed with respect to the mass referred to as the "orebody." Assays obtained from many samples were averaged in an endeavor to approximate the average assay value.

Such a procedure is obviously open to serious objection. Consistency of mineralization and of the value can be proved only by the sampling of a large number of workings systematically distributed with reference to lateral and vertical extent.

The vagaries of low-grade ore deposits have not been sufficiently discussed, but they are quite important in the consideration of any large low-grade ore deposit as is instanced in the present status of the Alaska Juneau mine, which now appears to be in an especially low-grade stage. Apparently a very large tonnage, approximating almost a million tons, is involved in the swing between higher and lower values and the reverse. In the instance of the Utah Copper mine an elaborate system of sampling and control is necessary to effect an approximately even grade of milling ore. Thus by a system of selection the extremes are compensated.

These foregoing instances throw doubt on the attempt to infer consistency of mineralization based on relatively few workings not systematically distributed, although geologically there may be apparent consistency. In the instance of the porphyry copper deposits churn-drill holes provided a number of small samples systematically distributed which subsequent results roughly corroborated.

Mining Engineers of Note

Otto Sussman

THE senior vice-president of the American Metal Co., in executive charge of the engineering and operating activities of the company's multifarious exploration, mining, and smelting enterprises, is Otto Sussman. Mr. Sussman does not agree with some people who believe that the opportunity for the young mining engineer is not as good as it once was. He feels that the changes in the methods of detecting and exploiting orebodies, necessitated by the growing scarcity of outcropping deposits, and the remarkable development of ore-treating processes, have complicated technical operations to such an extent that the young engineer is more in demand than ever. The American Metal Co. through its subsidiaries is searching for such men; it gives them every opportunity to develop and advance. "Assuming average technical ability," says Mr. Sussman, "if they have grit, they get along well. If they lack it, we soon find it out. A man looking for a soft life had better stay out of the mining industry." The company at present is developing a score of properties scattered over the western hemisphere. Incidentally, it does not confine its attentions exclusively to ventures where enough ore can be measured to assure a profitable enterprise. Mr. Sussman is proud of the work done by those on the large staff of engineers of which he is the head. He is generous in giving credit to his associates, and is too modest when he says that any one of half a dozen of them could step into his shoes, and that he never would be missed.

OTTO SUSSMAN

Mr. Sussman is a native of Bavaria, where he was born on the last day of January, 1879. As a student of chemistry at the Nuremberg technical school he visited Karlsbad, when seventeen years old. A small lead mine and smelter in the vicinity so fascinated him that he then and there made up his mind to be a mining engineer, and in pursuance of this laudable purpose he got a job in the mine during his vacation. Later, he found employment for short periods at the Mansfeld copper mines and at sundry potash mines before he received his degree as mining engineer from the Royal School of Mines at Clausthal. After a semester of post-graduate study in geology under Credner, he went to work at a small lead-zinc mine in the Tyrolean mountains as a sort of technical handy man, doing assaying and surveying as well as geologizing. A paper on the geology of the deposits won him a degree of Ph.D. at the University of Wuerzburg, and was published later in the *Transactions* of the Imperial and Royal Geological Survey of Austria. He was at this time twenty-two years old. A little later Mr. Sussman, like many young American engineers of today, answered an advertisement in a technical periodical for a man to go abroad. He got the job. The resulting report on the famous Ouenza iron deposits in Algiers was sufficiently convincing to enlist the financial support of an international syndicate, including the Thyssen and Krupp steel interests as well as his original clients. However, negotiations with the French Government to acquire it were unsuccessful. French concessionaires are now mining iron ore on a large scale. The same firm sent him to Brazil, and then to Spain. At this time he was earning the equivalent of $75 per month, which represented an increase of 50 per cent over the salary on which he started. On Feb. 26, 1904, he landed in the United States, having already arranged a connection with the interests that now form the American Metal Co. He has been with them ever since. He has made examinations of many well-known mines, including Granby, Butte & Superior, Callahan Zinc-Lead, Miami, Pecos, Climax Molybdenum, and Matahambre, in Cuba, and most of the mines in Mexico owned by the Peñoles company, the most important of the American Metal subsidiaries.

A few years ago it was the vogue in a sketch of this kind to mention a man's proclivity for golf. Now, however, there is no purpose in saying anything unless the subject has not made a success as a golfer. Mr. Sussman says that he handles a golf club like a sampling pick, with terrible results. He likes the wide, open spaces of the West. Last summer he and his fourteen-year-old daughter spent several weeks riding and "packing" through New Mexico. Mr. Sussman was the cook on this expedition.

Antimony in Bolivia

Development Hitherto Neglected Owing to Lack of Capital, but Good Profits Are Indicated at Present Prices—Deposits Numerous and of High Grade

By Law Voge
Chemical Engineer, New York City

THE PRESENCE OF STIBNITE in Bolivia has been known for centuries. Scientific travelers as early as the eighteenth century reported its occurrence in many parts of the country. Transportation was long difficult, so that French, Spanish, Japanese, East Indian, and Chinese sources of supply were preferred, the ore often being shipped cheaply as ballast. Some of the sources mentioned became exhausted in time, and years before the Panama Canal was built the Mexican deposits, because of their accessibility, were developed by the foremost English smelter.

During the World War, when production of antimony in Bolivia was stimulated by direct guarantees of European governments and through advances of capital, Bolivia rose to second place among the nations as a producer of antimony ore, in 1916 producing over 26,000 long tons to China's 45,000.

Deposits Widely Scattered

The stibnite deposits of Bolivia are widely scattered over almost the entire Alta, or high Andean level, of the country, from Lake Titicaca on the north to Tupiza and Atocha on the south and to Potosi on the east. They occur generally in black, Paleozoic shale and are almost wholly stibnite, the oxide found being generally near the surface and having been produced by weathering. It is frequently in quartz gangue. In the Department of Oruro, galena is sometimes present, and near Potosi the ores are sometimes argentiferous or auriferous. The veins vary in width from several inches up to 2 or 3 ft., but are invariably pockety—ending, but always being picked up again if the direction of the vein is followed. The principal areas mined during the war were near Atocha, in the south; Porco, in the east center, and Uncia, in the north of the Department of Potosi, and Palca, near La Paz.

With hand-cleaning, ore of 60 per cent metallic antimony content is readily produced from most of these mines, and carloads have not infrequently been shipped analyzing 68 per cent metallic antimony. Sample analyses of Bolivian stibnite, in per cent, are as follows:

Typical Analyses from Five Mines

1. Antimony (metal) 70.48; lead, 0.61
2. Antimony 62.13; lead 0.18; iron 1.63; antimony (as oxide) 0.5
3. Antimony 66.20; lead 0.33; iron 1.70; antimony (as oxide) 0.8
4. Antimony 61.88; lead 0.15; iron 1.61; antimony (as oxide) 0.8
5. Antimony 64.73; lead 0.34; iron 0.54
6. Antimony 69.82; lead 0.43; iron 0.52
7. Antimony 68.70; lead 0.37; iron 1.02; no antimony as oxide
8. Antimony 70.01; lead 0.34; arsenic 0.53

Analysis was not made for other impurities.

The ores analyzed were from five widely separated mines. Lead, iron, arsenic, and antimony oxide can easily be limited to one-half of 1 per cent each, in these Bolivian ores.

The stibnite deposits are at altitudes ranging from 13,000 ft. upward. Fuel is always scarce and water is scarce during certain months—July to September, the winter months—though there is generally sufficient for camp requirements and for concentration.

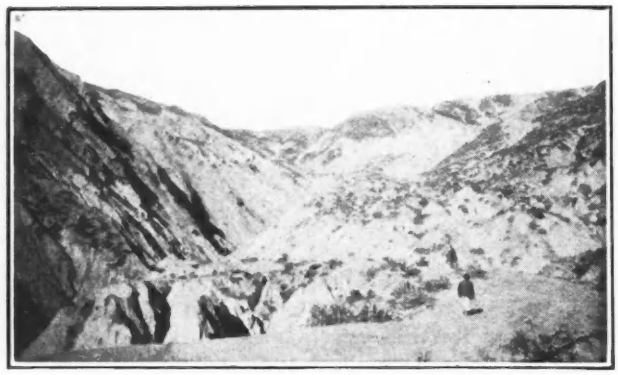
Mining methods are crude. Most of the veins are nearly vertical, and tunnels are drilled following the veins or with vertical shafts until striking the lode. The tunnels are placed about 100 ft. above each other. Stoping is seldom undertaken. Air drills are unknown.

Sketch map showing railroad outlets from the antimony districts of Bolivia

The ore is blasted out by the miners at so much per quintal, the unit of weight, of ore of the required purity—a piece-work system. It is brought to the mine entrance by wheelbarrows or in sacks and is there sorted by Indian women, who learn to distinguish what is 60 per cent ore or better.

It has been said that stibnite cannot be concentrated by water alone, owing to the easy formation of slime and consequent losses. I have not attempted to determine the losses, but I have run concentration tests on discarded dumps running, as shown by careful analysis, 20 per cent metallic antimony, raising the ore to 65 per cent by the simple *quimbaleta* (circular sheet-iron crusher) and washing and screening.

At the mine the ore is weighed into 50- or 100-lb. sacks and loaded on llamas, burros, or mules. The llama is the great beast of burden of the high altitudes, subsisting off of the country, however arid and barren it may be, whereas in some regions and for certain months, generally, fodder must be carried for burros and mules. The llama carries a load of 100 lb. of ore; if loaded with much more it lies down on the job.



In the antimony region of the Department of La Paz

Llamas travel slowly but surely—about 10 miles a day, but in nearly direct lines and frequently ignoring trails. Only an Indian can drive them, but one Indian can drive several hundred. The mule carries twice the weight of ore that the llama does, but the cost of transporting by mules is twice that performed by llamas.

Antimony mines are worked by Bolivians (generally of Spanish origin), *cholos* (part Spanish, part Indian), and Indians. The superintendent is generally a Bolivian; the mine boss and chief miners are *cholos;* and the hauling is done by Indians. The Indian, if fairly treated and allowed to celebrate his various fiestas, is a good worker and has few of the characteristics of his North American cousin. He is much more Mongolian in physique and nature, and his endurance, reinforced by his ever-present quid of coca leaves, is admirable.

Mine Supplies Easily Secured and Transported

All necessary mine supplies are readily available in the cities of Potosi, Oruro, and La Paz, and there is no dearth of experienced miners in the vicinity of the first-named two cities. Each mine has its *pulperia* or company store, where each miner buys his supplies, often at exorbitant rates, these charges being deducted from his monthly pay.

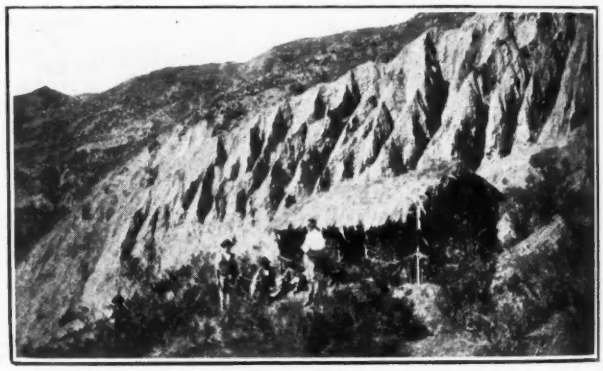
The miners' huts are of the crudest; sometimes they sleep in the mine tunnels. The huts are not infrequently made of cactus with thatched roofs of grass; occasionally mud huts with slate roofs are built, generally without windows and with half-height doors to make them warmer.

Hand forge, drills, fuse, dynamite, and carbide lamps constitute the equipment. Flour, rice, sardines, coca, cigarettes, coffee, and sun-dried meat constitute the personal supplies.

The mines are situated generally within 30 miles of a railroad. There are four railroad outlets for ore: To the south via Uyuni and Jujuy into the Argentine and to Buenos Aires (never used for United States exports); to the southwest, from Uyuni to the Chilean port of Antofagasta, about 370 miles; and in the north from La Paz to Arica, about 270 miles. The line from Uyuni to Antofagasta is not standard gage—all the others are. This means that ore arriving at Uyuni by any of the other three lines must be reloaded into the special-gaged cars, sometimes causing weeks of delay, as the railroad company is averse to carrying empty cars up from Antofagasta to Uyuni. Notwithstanding the strong advantages of the newer Arica route, most of the ore at present comes out at Antofagasta, as the mines along that route are more developed. Finally, there is the northern route to Lake Titicaca at Guaqui, thence by boat to Puno, and again by rail via Arequipa to the Peruvian port of Mollendo, totaling about 400 miles—a route seldom used for Bolivian ore, though much favored for Peruvian.

How the Export Tax Is Calculated

Recently the Bolivian Government considerably increased its export tax on all metals; partially, it was said, to defray the expenses of the Centennial Exposition recently held. The same tax, however, has now been renewed for another year. The tax on stibnite or other antimony ore now is based on the special tariff act on antimony which became a law on Feb. 28, 1924, and which has for its basis the price of the ore in the London market. When the London market price is under 6s. per unit (i.e., per per cent of metallic antimony in the ore), the tax is 44 Bolivian centavos per metric quintal (100 kilograms) of metallic antimony, or 4.40 bolivianos per metric ton (approximately a long ton). When the market price is between 6 and 8s. per unit of antimony, the tax is 44 centavos plus ½ centavo for each penny above 6s. up to 8s. when the tax is 56 centavos per unit. Above 8s. the tax is computed on a base of 56 centavos, augmented by 0.01 for each penny above 8s. For example, if the ore is 60 per cent antimony metal content and the London market price is 7s. per unit, the tax would be $0.06 \times (44 + 1_2^2)$ or 3.00 bolovianos per metric ton. If the ore carries more than



Miner's hut at one of the antimony mines

1½ kg. of fine silver per metric ton the tax fixed for silver is also paid on the percentage present, and a tax is similarly computed for other metals. The exporter must present the certificate of analysis. (*Boletin Comercial* An. 6, p. 17, 16 March, 1924.)

The present United States tariff law admits antimony ore, natural and unliquated, free of duty; needle or liquated antimony (sulphide) pays ¼c. per lb., and regulus or metal 2c. per lb.

The operation of antimony mines in Bolivia has been, almost without exception, on the basis of advances in money and supplies to the mine owner by some commercial house of Oruro, La Paz, or Potosi, any ore produced to be sold through that house on a commission basis and with deductions covering the advances made on each shipment, generally of 25 or 50 tons. These advances have been frequently made without any control or supervision on the part of the commercial house as to how they were to be expended, and often the money has not been used at the mines so that the production fell far short of that anticipated.

Most of the mines are purchasable, but at greatly inflated values, and there is generally a considerable

sum of back taxes to be paid; but the rental of antimony mines can be accomplished at very low figures on the basis of the weight of the ore exported and with a long-term option for purchase. This is undoubtedly the best way for foreign capital to begin antimony operation in Bolivia. Mine managers, especially those with any engineering training, are very scarce in the country and must be brought in. All other assistance is available.

Bolivian capital is difficult to secure. The question has sometimes been raised—by people trained to interpret statistics and stock quotations and to little else—why, if antimony is present in Bolivia in rich deposits, so little is exported except when the price is abnormally high. The answer is clear to any student of Bolivia or to one who has been in the country, however short the period; what Bolivian capital there is (and the Bolivian capitalists can be counted on the fingers of one hand) is more interested in tin and in silver; the small production is not due to lack of high-grade antimony ore or to excessive production costs. The production when the antimony market is abnormally high is due to guarantees and advances from foreign governments and financial houses to the mine owners. These mine owners generally own tin or silver mines also. The largest owner and producer of antimony mines in Bolivia in 1924 produced much other ore, and the value of his antimony output was but a third of that of his total ore production.

The following table shows the production of Bolivian stibnite in recent years:

Bolivian Production of Stibnite, in Long Tons

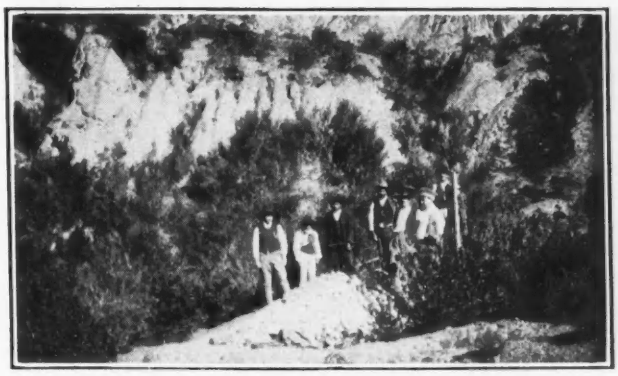
1917	(a) 26,000	1922	420
1918	6,836	1923	709
1919	238	1924	1,415
1920	11,100	1925	(b) 2,000
1921	640		

(a) *Approximately.* (b) Estimated.
Production in the first half of 1925 officially reported as 1,133 long tons.

Who are Bolivia's competitors in antimony production? The chief producer of stibnite about two centuries ago was Hungary. The mines there became exhausted; then France discovered and developed her mines and led in production until about 1908, when China took the lead and has maintained it. In recent years the Chinese production has been reduced and made uncertain through the revolution, which shows few signs of abatement. It is doubtful if Chinese antimony can ever be produced as cheaply as formerly, as high wages must be paid. Finally, much of the Chinese ore is so low in grade that it must be subjected to liquation before reducing to metal or using for antimony compounds, such as sulphuret, whereas Bolivian ore can be obtained of such high grade and in such quantity that liquation can be avoided.

Mexico produces much stibnite and of good grade; it contains frequently, however, large percentages of oxide, which precludes its use for salts or for sulphuret, but not for reduction to metal. The Mexican deposits have been largely controlled for many years by Cookson, the British refining company of Newcastle. United States deposits are few and of low grade, running about 30 per cent antimony. Other countries producing antimony ores, in the order of their importance are: Algeria (largely oxide); Victoria, Australia; Asia Minor; Italy; Yugoslavia; Austria, and Spain.

United States consumption of antimony, as refined metal, crude, and ore, has been steadily increasing. In 1924 the consumption was nearly 25 per cent greater than in 1921.



Stibnite from a newly opened mine in the Department of La Paz. Though the ore is black, it is so finely crystallized that in sunlight it photographs white

Consumption of Antimony in the United States
From "Metal Statistics"

Year	Tons of 2,000 Pounds	Year	Tons of 2,000 Pounds
1916	19,795	1920	17,684
1917	24,713	1921	16,387
1918	22,573	1922	17,860
1919	13,696	1923	18,013
		1924	20,065

The imports of antimony into the United States in recent years have been:

Antimony Imports into the United States
Antimony content of metal, crude, and ore

Year	Tons of 2,000 Pounds	Year	Tons of 2,000 Pounds
1916	11,686	1921	10,228
1917	17,118	1922	9,344
1918	15,436	1923	7,810
1919	7,568	1924	8,175
1920	10,499	1925	10,825

The imports of antimony ore at the port of New York in 1925 were only 800 long tons, largely because no more was available, as it is difficult to buy from China, the operators there preferring to make the profit on refining to regulus. The amount of antimony recovered from alloys in the United States has increased greatly in recent years.

Average prices of ordinary grades of antimony in New York have been as follows:

Average Yearly Prices of Antimony
In Cents per Pound

1911	7.54	1916	25.37	1921	4.96
1912	7.76	1917	20.69	1922	5.47
1913	7.52	1918	12.58	1923	7.90
1914	8.76	1919	8.19	1924	10.84
1915	30.28	1920	8.48	1925	17.49

Recent prices, which rose as high as 25c. per pound in January, have been almost up to the war peak in spite of the large imports of 1925.

The price fluctuations of stibnite, both the crude antimony sulphide and the liquated, follow closely those of the metal. The average price of powdered needle antimony for 1925 was 15c. per pound, or $336 per long ton, guaranteed 70 per cent antimony content.

Stibnite ore of 60 to 65 per cent antimony content can be produced in Bolivia and sold at a splendid profit for $130 to $150 per ton, today. There are 130 surveyed and recorded antimony mines in the departments of Potosi and La Paz alone, from the majority of which such operating results can be obtained. Antimony ore is not regularly quoted on the New York market, but it is stated on good authority that it can be smelted here profitably.

Llamas carrying 100-lb. loads of ore in strong native bags roped on with cords of llama wool

Having spent six months in Bolivia last year studying the antimony mining conditions, I am in possession of accurate and detailed figures of every item in the cost of production there. From these I conclude that Bolivia may very well one day replace China as the leading producer of this metal.

Metal-Mine Fatalities 418 in Year 1924

Accidents at mines producing metals and non-metallic minerals (except fuels) in the United States in the calendar year 1924 resulted in 418 deaths and 33,118 non-fatal accidents, according to returns made by operating companies to the U. S. Bureau of Mines, The fatality rate, 3.51 per thousand 300-day employees, was 0.50 per thousand higher than the previous year's rate, mainly because of the loss of forty-one lives in the Milford mine flood, in Minnesota, on Feb. 5, 1924. The non-fatal injury rate, 278 per thousand employees, was not materially different from the previous year's rate of 275. During the full ten-year period 1911-20 the average death rate was 3.85.

According to operators' returns to the Bureau of Mines, the industry employed 123,128 men in 1924, which is almost identical with the number of men working at the mines in the preceding year. Working time was equivalent to 35,734,008 man-shifts, a decline of about 2 per cent from the year before, and the year's operations averaged 290 workdays per man, a reduction of seven days per man.

Of the 33,536 accidents reported in 1924, only ten injuries resulted in permanent total disability.

Sponge Iron Patents

The publication of the statement in the Feb. 27 issue of the *Engineering and Mining Journal-Press*, page 372, that the Thornhill-Anderson sponge-iron process patent rights have been in litigation, is in error and we desire to correct this statement.

A New Siliceous Refractory

According to *The Southern Field*, a magazine published by the Southern Railway, a new siliceous refractory is being developed near Apison, Tenn. It appears to be an impure sandstone. On account of its physical and chemical resemblance to an Austrian refractory, known as "Baukite," it has been named "Baukite" and is now being produced by the American Baukite Co., Apison, Tenn. An analysis follows:

	Per Cent
SiO_2	95.84
Al_2O_3	1.51
TiO_2	1.33
Fe_2O_3	.71
CaO	.15
MgO	.40
CO_2	.06
	100.00

In tests made by the Pittsburgh Testing Laboratories, a brick made up of 50 per cent Baukite and 50 per cent common No. 2 fireclay successfully withstood a temperature of 3,146 deg. F. On a standard reheating test of five hours' duration at 2,552 deg. F., the specimen showed a contraction of 2.14 per cent. In the spalling test, the specimen withstood two immersions in water after heating to 2,462 deg. F. In a practical test made by a large brick company, using 50 per cent Baukite and 50 per cent high-grade fireclay, the specimen is reported to have withstood over 4,000 deg. F.

For repairing old furnace linings and coating new work, Baukite is said to have a distinct advantage in that it can be applied with a cement gun and the heat turned on while it is still moist. This is attributed to the fact that it has practically no expansion or contraction in drying.

Baukite has been successfully used as lime-kiln lining, in fact, its properties were discovered by its being used like ordinary sandstone as lining for a kiln near Knoxville, Tenn. It is thought to be very suitable for lining cement kilns also.

Cutting Mining Costs in the Southwest

Stoping Methods Changed or Modified—Systematizing of Operations Important

By Charles A. Mitke
Consulting Mining Engineer, Bisbee, Ariz.

DURING RECENT YEARS, the prevailing high cost of labor and supplies and the low price of copper have compelled many mine organizations in the Southwest to introduce changes in mining methods whereby the cost per ton could be lowered without materially reducing the grade of the ore produced. Changes in methods and practice consist principally in the replacement of old equipment; a better distribution of tools and supplies; introduction of bonus or contract systems; improved ventilation; substitution, or modification of stoping methods; and, in some instances, the application of the principles of "standardization" to underground practices. Results so far have been encouraging, and the mining cost has been lowered at many mines. At one particular mine, as a result of the adoption of a low-cost mining method, coupled with the application of standardization, both as regards operations and men, low-grade material, ranging from 12 to 20 lb. per ton, is paying substantial dividends on a 14½c. copper market. The various improvements in methods of mining referred to above will be outlined in the following paragraphs.

Tendencies in Choosing Equipment

Equipment—There is a gradual tendency toward the use of small drilling machines and lighter steel. Machines of jackhammer type are necessary at practically all mines for breaking boulders, as well as heavy drifting machines for hard ground. In mines where conditions permit, the use of the light jackhammer machine, with light steel, for drifting and stoping ground of medium hardness has affected a considerable saving.

The stoping machine, on the other hand, has a field of its own. In a few instances, however, adjustments have been made so that the same kind of steel may be used in both jackhammers and stopers. Where conditions are feasible, such a change is well worthy of consideration by any mine organization.

Old and worn-out machines are being replaced promptly by new ones and a better finish has been accomplished in the sharpening and tempering of drill bits.

There is a more general use of electric haulage. The storage-battery motor is used mainly as a gathering motor, to make up trains for motors of the trolley type, or to handle supplies.

Distribution of Tools and Supplies—In general, special trucks are now used for timber, tools, and powder, one of individual construction being used for each class of supplies. These special trucks are used both on surface and underground. In those cases where large cages are in use, the trucks, after being loaded on surface, are run directly on the cage, lowered, run off the cage, and taken direct to the underground storage place, the timber going to underground timber stations, while tools are routed to underground tool rooms, and powder to the explosives magazines.

Very little hand sawing is now done underground, as practically all timber is cut and framed to standard sizes on the surface.

Special Bosses for Distribution

Another step toward increased efficiency is the employment of supply bosses, so as to effect a better distribution of tools and supplies underground. These bosses, with their assistants, supervise the routing of tools and supplies through the mine, and insist upon a regular schedule being maintained, so that when the miners come on shift, instead of waiting for supplies, or having to go in search of tools themselves, everything is conveniently available, either at the working place or in suitable storage drifts, ready for them to begin work.

Bonus or Contract Systems—In most mines approximately 25 per cent of the underground force is either on bonus or contract. There is, after all, very little difference between the average contract and bonus system. Both guarantee day's pay, as the moment the contract rate falls below day's pay it either automatically terminates itself or the man is placed on day's wage, whereas bonus systems do not become operative until the miner makes over and above the scheduled daily wage.

Contract systems are usually based on a certain rate per foot, the figure agreed upon being an amount that it is believed will allow the man to make a sufficient advance over the day's wage to encourage him to perform the extra work. The bonus, on the other hand, is based on a sliding scale, depending on the character of ground, the amount of footage "pulled," and other factors. Both bonus and contract systems make it possible for the men, individually, to make anywhere from $1 to $5 a day above wages, but the average increase of all bonus men is usually from $1.50 to $2 per day.

Development Work Under Bonus System

In general, prospect and development work is put on bonus. The prospect and development branch of mining is usually behind at nearly all mines. When such headings are put on contract or bonus, they are, as a rule, driven at greater speed for less cost than when performed on day's pay. The ambitious miner usually prefers to be on contract or bonus work, as his earning power then is limited only by his own ingenuity and personal efforts.

In a few mines a bonus system is being developed for bosses and foremen, and, in exceptional cases, for men on stoping. However, the maintenance of the grade of the ore and prevention of dilution being such important items, very few companies have as yet been able to work out a satisfactory bonus system for stoping.

Regardless of objections that may be raised to having only 25 per cent of the working force on so-called bonus or contract, the advantages greatly outweigh the disadvantages.

Improved Ventilation—Good working conditions are just as essential as good tools. Continuous inhalation of vitiated air in hot, humid working places results in

lowering a man's efficiency, which, in turn, causes him to become dissatisfied with his job, and is one of the principal reasons for the large labor turnover in a good many camps. In those mines where the ventilation has been kept well abreast of the stoping, good tonnages and low costs are being obtained, whereas in those in which the ventilation has been somewhat neglected, the effects are reflected in both the lower tonnage produced per man as well as the increased costs.

Cheaper Mining Method

Substitution or Modification of Stoping Methods—In recent years many changes, or substitutions, have been made in methods of stoping various classes of ground. The following table illustrates some of the changes effected:

Former Method	Changed to
Square set	Square set with slides (or rills) / Mitchell system
Horizontal cut and fill	Incline cut and fill
Horizontal top slice	Caving (incline-raise system)

The most marked change has been from various methods of caving, including top-slicing, to the incline-raise system of caving; the tonnage mined by this latter method has been increased from approximately 17,000 tons to 27,000 tons per day.

In high-grade mines, in the average ground, square setting has been pretty well replaced with square sets and slides, timbered-rill stoping, and Mitchell stoping. Smaller stopes are now more generally used, such as 3 by 3- or 2 by 6-set sections, instead of the large blocks formerly taken, which ranged from 6 by 6- to 10 by 10-set sections.

In exceptional cases, such as stopes in heavy ground which also contains considerable sulphur or pyrite, the small-set section of 2 by 6 sets, with close filling and hand shoveling, has been found to be by far the safest method of minimizing fire risks.

Greater Level Intervals

A distinct saving has also been accomplished in development work in high-grade mines by increasing the interval between main levels connecting the shaft with the orebodies. Instead of driving main connecting levels every 100 ft. through waste, as formerly, these are now located at 200- and 300-ft. intervals. In the orebodies themselves, however, the 100-ft. interval for small sublevel drifts is, of course, still used for convenience in stoping.

Though approximately 2,500 tons per day is at present being stoped by the horizontal cut-and-fill method, there is a tendency toward the incline cut and fill. At present the tonnage mined by both the horizontal and incline methods is about equal. In ground containing many large waste boulders, which must be sorted out and left in the stope as fill, the horizontal method is still preferred, even though somewhat more expensive than the incline system.

Top-slicing, used generally in the iron mines of northern Michigan, introduced into northern Mexico some years ago, and later into Arizona, is fast disappearing from the mines of the Southwest. Ten years ago, more than 10,000 tons of ore daily was stoped by this method. Today, less than 1,000 tons is mined by top-slicing, as the incline-raise caving system has largely taken its place. Though essentially a caving system, top-slicing requires approximately the same quantity of timber as square setting and is, therefore, a very high-cost method.

The dilution of ore, when stoped by top-slicing, is low—estimated at approximately 5 per cent. However, in mining by the incline-raise caving system, it has been found possible, when the drawing is well controlled, to keep the dilution as low as 10 per cent. As the mining cost for top-slicing is usually two to five times that of the incline-raise system, it is apparent that where the increased dilution is slight, a decided advantage is gained by the greatly diminished mining cost.

The most important caving methods used for large tonnages in the Southwest today are:

Method	Approximate Daily Tonnage
Incline-drift system	1,000
Shrinkage with subsequent filling	2,500
Shrinkage with simultaneous pillar caving	10,000
Incline-raise system	27,000

The incline-drift system, as practiced in Morenci, provides for the ore being drawn through incline drifts into chutes, where the ore is measured. The incline drifts are timbered with regular drift sets, and where these drifts are carried to the apex along the ridge and connected, they provide two openings to the working place. The method of drawing off is similar to that of the incline-raise system, with the exception that the man who does the drawing works in a drift-set instead of a very heavy square set.

Shrinkage with subsequent filling is used in high-grade mines where the ore is firm and the walls and back stand readily without timber. After the stope is carried up and the ore drawn out, leaving a large underground cavity, the opening is then filled with waste. This method is now used only to a limited extent in several mining districts.

Shrinkage with simultaneous pillar caving ranks second in importance as regards daily tonnage extracted. It is suitable for flat orebodies in which shrinkage stopes are carried up, leaving pillars, and in the final draw the pillars are also undercut and drawn with the general mass of the ore. As all this ore is measured by being drawn into hand or motor cars, the drawing is well under control, as the tonnage from each chute is regulated, which brings the capping down evenly.

Incline-Raise Caving Important

The incline-raise system is the most important, as regards tonnage. A greater daily tonnage is drawn by this method in the Southwest than by all the other underground systems put together. By this method, all hand tramming is eliminated; the ore is drawn at the square sets, runs by gravity through the grizzly (where large boulders are broken), and from there right into the main haulage raises. Though it is difficult to measure the ore accurately from each finger raise, nevertheless certain approximations have been made, such as allowing from 25 to 75 tons of ore to be drawn from each finger raise—an amount sufficient to fill the ore chute beneath. When a number of these storage chutes are filled, they are then drawn empty by the motor crews. Another expedient used is to take time readings on a measured quantity of ore as it runs from the finger raises, and use that measure of time as an approximation for a certain tonnage. Large boulders of hard rock and wet ore present difficulties in drawing off the required tonnage in the specified time. However, if sufficient care is exercised, experience has shown that the drawing off may be fairly accurate by this method without excessive dilution.

Though numerous experiments have been tried out to improve the incline-raise system, up to the present no fundamental changes have been developed since its introduction in the low-grade mines of Arizona some years ago. One of the recent minor improvements, however, has been the strengthening of the square set in which the chute-tapper works. Cribbing has also been extended up the four-finger raises served by the square set for a distance of from 1 to 3 ft., depending on the firmness of the ground, the object of this being to distribute the drawing more evenly over the area allotted to each of the finger raises. The largest tonnages per man, in underground mining, are obtained at present with this system.

Standardization—Although all the above-mentioned changes and modifications have resulted in a decrease in operating costs, the most marked results have been obtained where such changes have been accompanied by the application of the principles of standardization to both operations and men. For example, at one particular mine practically all the high-grade ore had been exhausted and the life of the entire enterprise was at stake unless the extremely low-grade material (0.6 to 1 per cent copper), hitherto considered non-commercial, could be mined at a profit. As a first step, the lowest cost underground stoping system (the incline-raise system) was adopted, by which a daily tonnage of approximately 15 to 20 tons per man could be produced. Even this low-cost system (ranging from 60c. to 80c. per ton), however, with its large daily tonnage per man, was too expensive for the low-grade material to pay operating costs and yield the desired profit.

Management of Labor Big Factor

The next step was the standardization of operations and a more thorough classification of the underground force. The men were moved around from one job to another until it was learned just which job each particular man could do best. He was then allowed to follow up this branch of mining, so as to perfect himself in one special class of work, even though it might be a very humble task. All preparatory work in stoping was contracted to various groups of contractors, who performed different stages in developing a block of ground, each group specializing in his particular unit of work. Approximately ten different stages, or units, are required to bring a block of ground to full production. There are thus ten different classes of work to which men must be fitted.

This fitting the man to the job and getting the job down to a regular routine is usually known as "standardization"—the application of common-sense business principles to any line of industry.

By uniting standardization with a low-cost mining method, the tonnage per man at the property referred to above has been raised to 26 tons, and the mining cost reduced to the remarkable figure of 40c. a ton. The result is that this property will be able to show a good profit on a 14½c. market, when mining ore containing only 12 to 20 lb. copper per ton.

Many of the large domestic producers of copper must in the comparatively near future face the same problems that the company under discussion is solving so satisfactorily. A large number of these are mining lower-grade ores today than they did five years ago, and, in all probability, must work on still lower-grade ores five years hence. To meet this situation they will either have to receive an increasing price for their copper, or work out some method of lowering costs. If the latter becomes a necessity, it is quite apparent that there will be a premium on more economical production methods. It is therefore logical to assume that frequent surveys of all underground operations and the more general application of the best standardized methods may effect economies which will enable operators to meet these changing conditions.

Estimates show that in metal mining more than 50 per cent of the total cost of production is chargeable to labor; therefore the proper directing and systematizing of the activities of labor is a very important factor in the standardization of mining operations.

In standardizing underground work, three fundamental considerations apply to all mines: In the first place, good working conditions must be provided. In the second, every detail connected with the work must be analyzed so as to permit of standardization of the various jobs, whether it is in preparatory work for mining or actual stoping. Third, a more thorough classification of the working force must be attained so as to place each man in the job for which he is best fitted.

A Coal Situation

By D. E. A. Charlton

"This 'ere fuss tha miners an' tha coal h'operators 'ave 'ad," said Cap'n Dick, "puts me in mind o' sumthin' that 'appened h'out h'in Grass Valley h'eight h'or ten year h'ago. We 'ad one o' these 'igh-strung college chaps 'oo wanted to naw baout h'every thin, an' seemed to be h'up h'on 'is toes h'on h'all that wuz gawin raoun tha mine. 'Ee wuz surface boss, an I mus' say 'ee kep things h'in neat and fitty shape. Daown by tha creek that ran near tha shaf' we 'ad a pumpin' plant that wuz used for to fill a tank that wuz used h'in case o' fire, an one day 'ee wuz geekin' raound an' come 'cross sumthin' that started im runnin' 'is legs h'off back to the h'engine 'ouse. 'Jim' 'ee sez, brethles-like, 'Some bloody fool be figgern' for to blaw h'up tha works, for there's no water showin' h'in tha gage h'on tha boiler h'at that pump 'ouse!' So h'out they both rushes an' daown to tha pump 'ouse. W'en they got there Jim thrawed h'open tha fire-door an saw right h'away that there wuz no sign o' fire h'or 'eat. 'Dam -me,' sez 'ee, 'guess tha bes' thing be for both o' we to get back to work.'"

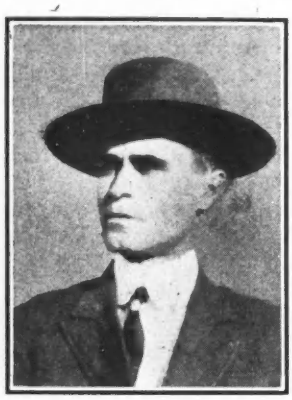
African Outlets for Mining Machinery Appreciated in Germany

A number of mining concerns in the Southwest Protectorate (formerly a German colony) are purchasing mining machinery on a fairly generous scale at the present time, according to Perry J. Stevenson, U. S. Trade Commissioner at Johannesburg, South Africa. In 1924 mining equipment imported into the Southwest Protectorate totaled £54,584 in value, of which £46,099, or more than 80 per cent, was supplied by Germany, £3,745 by the United States, and £1,610 by the United Kingdom. Of the South African total, which was £3,109, £1,113 was of South African origin and £1,996 represented re-exports. Large developments are expected in the near future in connection with copper in the Southwest Protectorate, and they should also result in increased purchases of plant equipment.

Do All Gulf Salt Domes Have Vents?

Some Conclusions From Data Recorded in Swamps of South Louisiana Which Tend to Prove That They Have—Domes Should Be Studied as a Unit

By Richard B. Thacker
Civil Engineer, 2102 McKinney Ave., Houston, Tex.



Richard B. Thacker

IF THE HIGHLAND salt domes of Texas could be submerged as is much of the territory of south Louisiana, I am reasonably sure that evidence of their presence would at some time appear about the domes in the form of "permanently bubbling gas pools," "ripple bubbles," and oil seepages. These so-called permanently bubbling gas pools, as recorded on maps of the lake and swamp waters of south Louisiana, are due to continuously escaping gases, which cause the waters over areas of a few feet to 100 ft. in diameter to bubble constantly. The ripple bubbles, as recorded on these maps, are made by spasmodically escaping gases that cause little ripples to run for long or short distances along the surface water, like those produced by the protruding fin of a big fish swiftly darting just below the surface.

Oil seepages call for no comment further than to state that of all the alleged occurrences that it has fallen to my lot to investigate during my entire activity in the Coastal territory, probably more than ninety-nine out of every hundred were put there as "plants" or "salts" by some ambitious property owner or someone interested in the project, for me to find them; and that all the real oil seepages that have ever been recorded by me, over a period of twenty-five years, could be counted on the fingers of my hands.

Domes Should Be Studied as a Unit

My object in writing this article is to present to those interested some data recorded in the swamps of south Louisiana, which, I believe, lead one to think that the problems of the Gulf Coast saline domes should be worked as a unit, if we are to learn anything more about these phenomena. If we study the domes as a unit and not for any particular fractional holdings, and make our deductions and drilling locations from all data that have been collected over a period of years, regardless of whose property the locations fall upon, we surely shall render better service to the oil fraternity than by other methods of procedure.

We have as evidence the permanently bubbling gas pool in Lake Piegneur, which is the only recorded permanent exhaust for the big Jefferson Island salt dome. This pool covers an area about 100 ft. in diameter and is in constant agitation, acting as an outlet for the surplus gas from the salt dome, which extends under the lake. The land portion of Jefferson Island rises to a height of 75 ft. and covers an area of ground of approximately 206 acres. This salt mass can be traced through the ripple bubbles (gas coming up around the edge of the dome) and is found to cover an area of about 625 acres which is submerged under the waters of Lake Piegneur.

Salt is mined from the 900-ft. level of the dome, the best grade being found in the direction toward the lake. The greatest trouble with gas encountered in the mine is in the southeast side of the workings which is within possibly a few hundred feet of the side of the salt mass. Mining of salt in this direction will not be extended, for fear of gas accumulating in the mine in such quantity as to injure the property.

Gas Pools Are Vents of Sunken Salt Domes

The Jefferson Island and Avery Island data present unusual opportunities of studying the salt domes from within, and anyone intending to follow the oil-finding branch of this business on the Gulf cannot afford to ignore these data. Were it possible to stop the flow of gas in Lake Piegneur, it is likely that other bubbling gas pools would appear somewhere around this dome in the lake, or that ground cracks would open up on the land portion of the dome to give an exhaust for the accumulating gas. I believe this would hold good for every Gulf Coast salt dome.

In prospecting for petroleum in the swamps of south Louisiana I classify the permanently bubbling gas pools as gas exhausts or vents of sunken salt domes, and where I have located one or more of these gas pools on any particular territory, I search for the ripple bubbles which, I believe, are the markers for the outer edges of the submerged domes. If I succeed in finding a reasonable number of these ripple bubbles near or within the bounds of one or more permanently bubbling gas pools, I supply the distances between the ripple bubbles and plat the supposed bounds of the newly located submerged salt domes. When these are eventually drilled, I believe they will prove up the salt masses. My next step in this work is to search the outer edges of the submerged dome for a distance of a half mile in all directions for indications of oil seepages.

Drilling Inadvisable Before Enough Data Have Been Collected

As all petroleum prospecting, surveying, tying in of data to section lines, and similar work in this region must be carried on for the most part in swamp territory, covered with from several inches to 3 ft. of water the year around, it requires time and patience. But the hardest part of my work, after officials have gone over my reports and seen so much bubbling gas on their properties, is to prevent them from making futile drilling attempts in and around these indications of escaping gas, until I have recorded sufficient data to

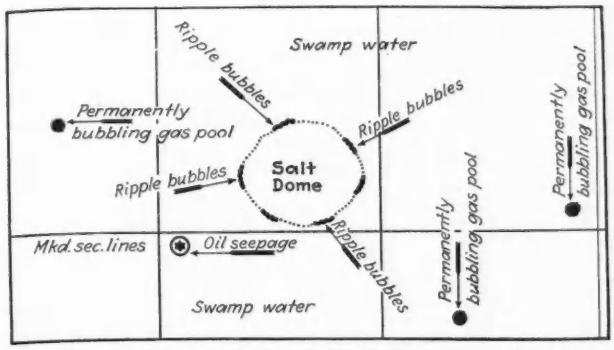


Fig. 1—Surface data platted for swamp dome, Louisiana

warrant making drilling locations. As this requires time, they have in some instances disregarded my advice in the matter, and have drilled and are now drilling over these gas pools, which work will probably result in nothing more than a series of dry holes.

My interpretation of the data when collected is platted, and with a written report of the work in hand, the parties interested make an inspection trip to all permanently bubbling gas pools; all ripple bubbles are traced out on the surface of the waters if those interested have the inclination and time to wait for them to appear (in some cases several weeks are required); and such data as I have supplied in connecting up this work are made known and pointed out on the ground.

If oil seepages have been recorded on any part of the lands, these are given the highest rating of all data recorded, and additional time is devoted to further exploration work in their immediate vicinity with the view of obtaining telltale data through the escaping

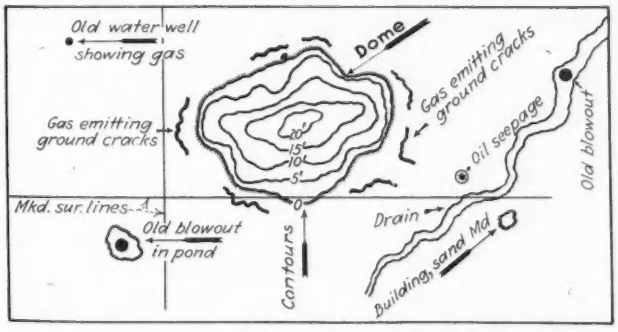


Fig. 3—Surface data platted for a highland dome, Texas

gas or oil on the water surface that will point to the direction and extent of the probable productive area.

As the escaping gases and oil from the salt domes do not come to the surface along perpendicular lines directly above where they are really located in volume, it would not show good judgment to drill directly where such indications are found with the expectation of drilling into the oil pools (this has been proven by the drill and I have the logs to refer to), for these more or less volatile substances in their upward journeys of several thousand feet have been proved to have traveled in their zigzag courses equally as far along horizontal lines before reaching the surface. To drill a test near or directly in one of these bubbling gas pools will only result in a feeble gas-showing down to the first loose stratum, usually sand and gravel. When drilling is done beyond this point, the gas will stop. The oil pools of a dome may be located two miles away on the opposite side from where one of these permanently bubbling gas pools has been recorded; through and along the lines of least resistance the gas has found its way around the salt mass. Permanently bubbling gas pools do not indicate the productive areas of a saline dome, and the only value that I attribute to recording a series of these gas pools on any territory is that they point to the probability of a sunken saline dome near by.

One Vent Indicates Existence of Others

If the investigator has been encouraged by having recorded or having had some native point out one of the permanently bubbling gas pools on any territory in the swamps or lake waters of south Louisiana, he should follow this up with careful exploration for other gas pools within a radius of two miles. It has been my experience that other such gas vents or exhausts exist,

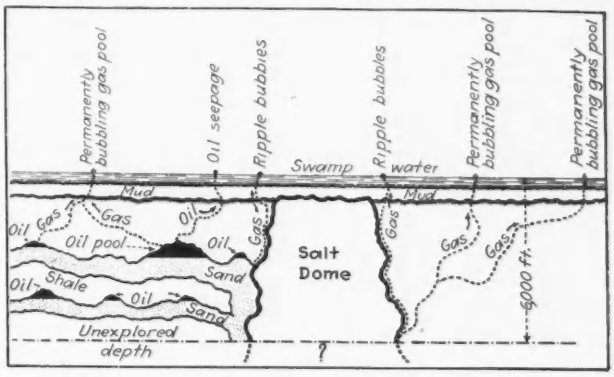


Fig. 2—Theoretical section of a swamp dome, Louisiana

and in one particular instance in Lafourche Parish I recorded as many as five such permanently bubbling gas pools, which, when platted, formed a circle, within which much interesting data in the form of ripple bubbles and oil seepages have been found.

Ripple bubbles located within the bounds of a series of permanently bubbling gas pools indicate the approximate bounds of a salt mass, and to drill a test within these markings would probably result in drilling into salt.

With only these data recorded on south Louisiana territory we have not sufficient information at hand to warrant making a drilling location, for at this point in our exploration we have reached only the stage that might be determined from the levels of any of our Texas highland domes. That is, we probably will drill into salt at any point where the levels of the highland domes show a higher elevation than is shown on the adjacent territory (the ripple bubbles mark this in

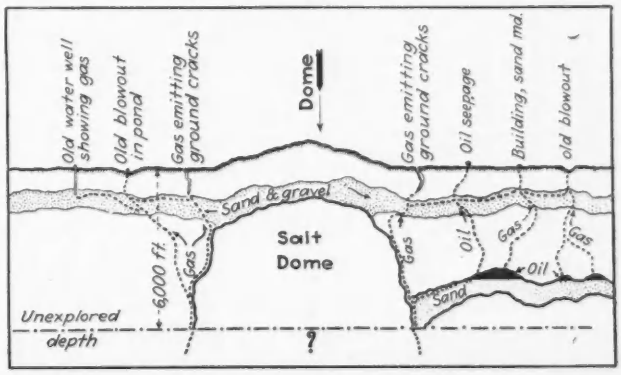


Fig. 4—Theoretical section of a highland dome, Texas

Louisiana territory), and if we expect to drill into the oil pool we must either record more data or drill around the salt mass for an indefinite period until the productive area is discovered.

Ripple bubbles on the water surface are probably produced by the accumulation of gases that follow upward along the irregular sides of the salt masses and which, when they have traveled the entire distances to the top of the salt walls, almost to the surface, force their way through the mud and water just above the outer edges of the salt plugs and escape into the air. My explanation for their appearance on the surface water at intervals of indefinite length is that a sufficient amount of gas must accumulate around the edge of the dome to blow a crack or crevice through the mud and water, and this gas may accumulate and blow out in the forms of ripple bubbles at any point above the edge of the salt dome. A plausible explanation as to why the gas escapes and shows on the surface water in the form of long streaks or ripples is probably that it accumulates along the edge of the dome in that shape, and as it blows its way through the mud and water it conforms more or less with the position in which it was released.

After an oil seepage has been recorded adjacent to the ripple bubbles, as south Louisiana swamp data or the gas-emitting surface cracks on the Texas highland domes, it is my belief that three-fourths of this territory may be eliminated and discarded as probably nonproductive of oil in volume and that all efforts should be concentrated on an intensive study of the area between the oil seepage and the dome markings, until some specific recommendations will justify the driving of a stake for a deep drilling test.

Many of the lakes in the swamps of south Louisiana, I believe, are eroded salt domes, dissolved and washed down by many high-water periods and overflows, but the telltale vents in the forms of bubbling gas pools, ripple bubbles, and oil seepages are there for us to record and study, and scattered through the inundated swamps of south Louisiana this class of data is met with as often as the known locations of the highland salt domes of Texas.

Zinc Distillation in Vertical Retorts

C. Rott in *Feuerungstech.* (1926, Vol. 14, pp. 85-86), abstracted in *Chemistry & Industry*, gives a description, with reference to plans, of a furnace for the distillation of zinc from ores in vertical retorts, sixteen of which replace the usual thirty-two horizontal retorts in a furnace of the normal size. The retorts consist of oval fireclay tubes with movable bottoms through which the residues may be discharged into wagons running below the furnace so that no zinc fumes escape into the air. The upper ends of the retort are funnel-shaped to take a beveled lid, which may be readily removed for charging the retorts from tilting wagons running along the top of the furnace. Along the middle of the furnace below the retort level a large mixing chamber is provided, in which preheated air and producer gas from lignite are mixed and from which the gas passes into the combustion chambers around each retort. The producer-gas inlet flue is below and the air-preheating flues are on either side of the mixing chamber; the flues for removing the burnt gases are on either side of the gas inlet flue. Condensers, which are larger than those usually employed, owing to the retort charge being more than twice as large, project just inside the upper part of the retorts. The furnace is more easily operated, requires less labor in recharging and discharging the retorts and in the manufacture and replacement of retorts, and has lower running costs and a larger output than that with horizontal retorts.

Two Methods of Producing Ductile Welds

Two methods for producing ductile welds have been developed by research scientists of the General Electric Co., working in different laboratories hundreds of miles apart. Both of the methods, similar in some respects, mark a decided step in the utilization of the heat of electric arcs in the joining of metal parts in shop repair or construction work, or in the building of metal structures. The one was developed in the Schenectady research laboratory by Dr. Irving Langmuir; the other in the Thomson research laboratory at Lynn, Mass., by Peter Alexander.

In both processes, air is excluded from the metal by means of a bath of hydrogen or other gas. The formation of oxides and nitrides in the weld metal is thus prevented, and the fused metal is as strong and ductile as the original metal.

Announcements of these radically new methods of arc welding are made in the March issue of the *General Electric Review*. In brief, the method developed by Dr. Langmuir in Schenectady is to pass a stream of hydrogen between two electrodes. The heat of the arc breaks up the hydrogen molecules into atoms. These combine again a short distance in front of the arc into molecules of the gas, and in so doing liberate an enormous amount of heat, so that much higher temperatures can be obtained with this than with the usual welding methods. Since atomic hydrogen is a powerful reducing agent, it reduces any oxides which might otherwise form on the surface of the metal. Alloys containing chromium, aluminum, silicon, or manganese can thus be welded without the use of fluxes and without producing surface oxidation.

The process developed in the Lynn laboratory by Mr. Alexander is based on the utilization of the chemical and physical properties of hydrogen and other gases in their molecular state. This process aims primarily at the prevention of the formation of the nitrides and oxides in the arc-deposited metal, which limit the ductility of the usual arc welds. In this process the arc is struck between the metallic wire or carbon used as one electrode and the plate or work to be welded used as another electrode. The crater of the arc is always on the work to be welded. The gaseous atmosphere is supplied in a form of a stream around the arc. Pure hydrogen, water gas, hydrogen-nitrogen mixtures, anhydrous ammonia, methanol vapor, and some other suitable gases can be used, according to the nature of the work. The hydrogen-carbon monoxide mixtures were suggested by Prof. Elihu Thomson; water gas and methanol are examples of such mixtures.

This process makes the arc-welding process more efficient and suitable for the fields which at present are out of its reach. Low-carbon steel, alloy steels, and most of the non-ferrous metals and alloys can be welded with success by this process in suitable gaseous mixtures.

Phosphorus Iron Ores on the Cuyuna Range

Geologic Series Grouped Into Three Classes—Phosphorus Largely the Result of Concentration—Deposits Widely Distributed

By George A. Thiel
Department of Geology and Mineralogy, University of Minnesota, Minneapolis, Minn.

THE IRON ORES in the Cuyuna range, Minnesota, are commonly grouped into two classes on the basis of their phosphorus content. These are the so-called "low-phosphorus high-silica" ores and the "high-phosphorus low-silica" ores. In addition to the merchantable ores there are numerous orebodies, some of sufficient size to warrant operation, in which the phosphorus content is too high for present-day furnace practice. The object of this paper is to point out a possible origin for much of the phosphorus now in the ores and to offer a suggestion with reference to its erratic distribution in some of the orebodies.

General Geological Relations.

Rocks of the Cuyuna district, Minnesota, have been grouped into three classes:[1] (1) metamorphosed, sedimentary and igneous rocks alternating each other in beds and lenses, usually with a steep dip due to extensive folding; (2) igneous rocks intruded into the metamorphosed rocks subsequent to their metamorphism and deformation; and (3) younger strata which lie horizontally on the eroded surface of the older rocks.

Included in the first class are the iron-bearing formations which are composed of interbedded chloritic, micaceous, quartzose, and hematitic schists and associated lenses of cherty iron carbonate, slate, and quartzite. The cherts are ferruginous and either massive or banded. Ore beds high in carbonate are usually green, fine-grained, and somewhat argillaceous. The slates are banded rocks locally high in amphibole and fine-grained magnetite.

Rocks of the second class are but slightly altered. These occur as sills, dikes, and irregular intrusive masses cutting all of the older formations. The larger masses are mostly basic, but many silicic veins and stringers with typical high-temperature minerals are found cutting the members of the iron-bearing series. Association of the silicic stringers with the basic masses suggests a common origin, and will be described in more detail later in this article.

Distribution of Phosphorus—A comparative study of the amount and distribution of phosphorus in the protores of the Cuyuna range shows a much higher percentage of P_2O_5 than in the protores of the Mesabi range. Fifteen analysis of characteristic Mesabi taconite and paint rock[2] gave an average of 0.0751 per cent P_2O_5. A similar calculation from analyses of Cuyuna range protores gave an average of 0.6732 per cent P_2O_5, which is approximately nine times as great as the Mesabi figure. Table I shows the wide range that is characteristic of the distribution of phosphorus in the iron-bearing formation of the Cuyuna district.

Table I—Percentage P_2O_5 in Typical Specimens of Iron-Bearing Rocks of the Cuyuna District[3]

	Per Cent P_2O_5
1. Massive, dark gray, argillaceous iron carbonate rock from Kennedy mine	4.019
2. Greenish black, laminated amphibole-magnetite rock, Adams mine, Deerwood	1.090
3. Massive pink ferruginous chert cut by high-temperature veins, Mangan No. 2 mine	1.100
4. Grayish-green chloritic schist, Kennedy mine	0.987
5. Amphibolitic slate, Mangan No. 2 mine	0.572
6. Hard, dense, ferruginous chert, Rowe mine	0.263
7. Banded ferruginous chert, Kennedy mine	0.077

An equally striking range in the distribution of phosphorus is observed in the ores. Table II shows its average distribution in the four classes of ores shipped from the Cuyuna district. In several bodies of non-merchantable ore an average of over 1 per cent of P_2O_5 is present, whereas, in some of the bessemer ore, percentages as low as 0.012 P_2O_5 are reported. In many cases abrupt changes in the content of phosphorus are encountered along the strike of the ore formation. Such changes are not evident from a study of cargo analyses, as the ores are mixed to maintain a nearly uniform grade.

Table II—Average Percentage of P_2O_5 in Various Cuyuna Range Ores[4]

	Per Cent P_2O_5
Bessemer	0.043
Non-bessemer:	
Low-phosphorus high-silica	0.073
High-phosphorus low-silica	0.170
Manganiferous	0.241

Phosphorus a Concentration Product

In the ores of the Mesabi range the phosphorus content is a concentration and not a residual product.[5] The slightly altered greenalite rocks contain little or no phosphorus, whereas the ores uniformly show a small amount. This same relation is true of the slates in the iron formation. The paint rock derived from the slates shows a higher phosphorus content than the original rocks. Leith gives evidence to show that much of the phosphorus has been carried into the ore by the leaching of overlying Cretaceous sediments and the weathering of the greenstone and granite bordering the iron formation.

On the Cuyuna range some of the phosphorus undoubtedly has been carried into the orebodies by processes similar to those active on the Mesabi. However, the amount of phosphorus in the ore is, in many cases, lower than in the protore. Therefore, concentration by the agency of percolating ground waters does not in itself account for the present distribution of all of the phosphorus.

In a previous paper[6] I described in detail various types

*Published by permission of the Director of the Minnesota Geological Survey.

[1]Harder, E. C., and Johnston, A. W.: Bull. 15. Minnesota Geological Survey, 1918.

[2]Leith, C. K.: U. S. Geological Survey, *Mono.* 52, 1911; Gruner, J. W.: Minnesota Geological Survey, *Bull.* 19, 1924.

[3]For complete analyses see Minnesota Geological Survey, *Bull.* 15, p. 150.

[4]Compiled by J. J. Craig, Minnesota School of Mines Experiment Station, Minneapolis, Minn.

[5]Leith, C. K., *Op. cit.*

[6]Thiel, G. A.: "High-temperature Manganese Veins of the Cuyuna Range," *Econ. Geol.*, Vol. 19, p. 377, 1924.

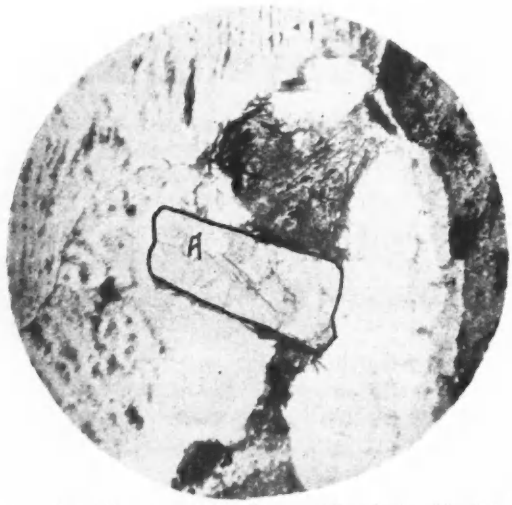


Fig. 1—Apatite crystals (A, outlined in black) associated with quartz and biotite in a microscopic stringer cutting the wall rock at the Bonnie Bell mine. X 80

of high-temperature veins cutting the Deerwood formation. Where the ore has been concentrated the veins are decomposed and lose their identity. In the wall rock, however, all stages, from veins partially replaced by manganese and iron oxides to those with fresh, unaltered, high-temperature constituents are readily located. Such veins are present in the entire region that has produced ore. On the South Range they have been found at the Brainerd, Wilcox, and Adams mines, and on the North Range they are present in its southwest extremity at the Sagamore pit. At the group of mines in the region of Mahnomen Lake, including the Louise, Mangan, and Merritt mines, many of the veins are coarse and pegmatitic. Further toward the northeast at the Milford mine and north of Rabbit Lake at the Northland mine, fresh, unaltered veins from less than an inch to over a foot in width cut the metamorphosed sediments.

Phosphorus in Form of Apatite—Apatite crystals are numerous in many of the veins. In the course of quartz-biotite-apatite-specularite veins the apatite is present as reddish-brown crystals over a centimeter in length. Fig. 1 shows a nearly colorless apatite crystal associated with quartz and biotite in a minute stringer a few millimeters in width. Such stringers are locally very numerous and form a network in the slates.

The apatite is not all confined to the veinlets. A study of microscopic thin sections of various phases of the Deerwood formation reveals apatite grains in both cherty and slaty phases. In the South Range it is present in the amphibole-magnetite slates and in the North Range it is locally abundant in the cherts near veins with high-temperature constituents. Fig. 2 shows a cherty magnetite-martite rock taken near the wall of a vein. Numerous microscopic grains of apatite are present. The rock yields 1.10 per cent P_2O_5. (See sample No. 2 in Table III.)

Table III—Showing the Percentage of P_2O_5 in High-Temperature and Associated Rocks from the Cuyuna Range

(R. J. Leonard, analyst)

	Per Cent P_2O_5
1. Quartz-biotite-apatite-specularite vein cutting ferruginous chert....	1.76
2. Ferruginous chert from wall of vein. Apatite visible in thin section	1.10
3. Partly leached ferruginous chert high in iron oxide from same stratum as No. 2.....	0.06
4. Magnetite-martite chert from stratum cut by numerous high-temperature veins.....	3.50

Apatite in the Cuyuna ores has been identified[1] by both microscopic and chemical analyses. The apatite occurs as globular and conical encrustations on walls of fractures and as a lining of vugs and cavities in the hard ore. Its mode of occurrence clearly indicates secondary concentration in the ore by the same processes that gave rise to the orebodies. With the leaching of the silica and the partial disintegration of the iron formation, some of the apatite in the veins and in the iron formation was dissolved and redeposited in the globular form.

Source of Apatite—Small dikes, sills, and large intrusive masses of dark subsilicic igneous rocks are abundant in the Cuyuna district. Fig. 4 is an outline map of east-central Minnesota showing localities where igneous rocks high in apatite have been encountered in mining or exploratory operations. Most of the intrusives are to the south of the deposits of merchantable

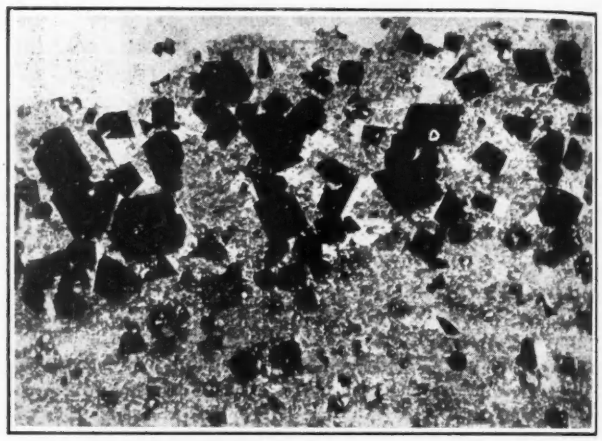


Fig. 2—Photomicrograph of a cherty magnetite-martite rock near the wall of a high-temperature vein. X 10

Numerous grains of apatite—not visible with this magnification—are associated with the magnetite in rocks of this type.

ore, but several large basic masses are closely associated with the orebodies on the North Range. Apatite is an essential constituent of many of the basic rocks.

At the Bonnie Bell mine granitic stringers with apatite grains are derived from a diabasic diorite intrusive. At the Adams mine the shaft cuts through a dark-green diabase altered to a groundmass of fine-grained chlorite in which are abundant, long, narrow laths of pink feldspar phenocrysts. Large apatite grains are visible in thin section in both the chlorite and feldspar. The field relations clearly indicate that the diabase is an intrusive, for on nearing the contact with the magnetite slate along the main drift, the diabase loses its porphyritic texture and becomes very fine grained and ophitic. Although no apophyses were observed at the contact, the high-temperature veins in the wall rock undoubtedly owe their origin to the large diabasic mass.

The intrusive rocks to the southwest of the Cuyuna range are especially high in apatite. In townships 132 and 133 N., Range 32 W., a large gabbro mass with associated anorthosite differentiates locally contains segregations of apatite. In thin section apatite is abundant in all phases of the rock. It occurs as stout euhedral prisms up to several millimeters in length in each of the essential minerals of the rock, and is particularly abundant in the secondary hornblende, Fig. 3,

[1]Head, R. E., microscopist, U. S. Bureau of Mines, Salt Lake City. Personal communication.

where numerous groups of long apatite crystals in a matrix of hornblende give the rock a texture similar to the laths of plagioclase in a diabase. Typical specimens of the rock yield an average of 1.95 per cent of P_2O_5.

This widespread presence of large amounts of apatite in the igneous masses and in the stringers at great distance from the intrusives suggests that magma high in phosphates was injected into the Deerwood series, and emanations penetrating into the minute joints and fissures locally deposited conspicuous amounts of apatite in the iron-bearing formation. Microscopic and chemical analyses of the veins and wall rock support such an interpretation. During the concentration of the ore, meteoric waters redistributed the phosphorus, depositing the greatest amount in the slaty phases high in alumina and low in silica. Some may have been added to the ore by the weathering of the basic rocks, but undoubtedly a considerable amount is residual.

Experiments to Determine Solubility

The solubility of phosphorus-bearing minerals and the concentration of phosphates by meteoric solutions has been previously demonstrated.[8] To determine the leaching effect of surface waters on the phosphorus in the various phases of the Deerwood series, samples of typical ores and protores were ground to 100 mesh and saturated with a solution containing equal parts of

Fig. 3—Apatite crystals, white, in a gabbro intrusive cutting the Cuyuna iron formation. X 60

spring water issuing from the base of the glacial drift and a humic acid solution obtained by leaching peat. Samples of 50 gm. each were placed in small funnels, and one liter of the solution was added a drop at a time and allowed to percolate through the sample and escape through a filter. After leaching for a period of thirty days, the increase in the amount of phosphorus in the solution was determined and the results were compared with analyses of the ground samples before and after leaching. Table IV is a compilation of the results.

Each of the samples showed an appreciable loss, but the soft limonitic and manganiferous slates held to their phosphorus most tenaciously.

The laboratory evidence here recorded, in favor of the redistribution of phosphorus through the action of meteoric solutions, is supported by the high-phosphorus content of most of the concretionary iron and manganese ores and by other types of concentrations that are typically secondary. A picked sample of "kidney ore" lining a fracture contained over 1 per cent P_2O_5. It is, therefore, evident that the same waters that aided in the concentration of iron and manganese carried some phosphates in solution also.

Table IV—Solubility of Phosphorus-Bearing Constituents of Cuyuna Range Ores and Protores in Meteoric Solutions

(J. H. McCarthy, Analyst)

Sample	Per Cent P_2O_5 Before Leaching	Per Cent P_2O_5 After Leaching	Per Cent P_2O_5 Loss
Manganiferous iron ore, Sagamore pit	0.662	0.651	0.011
Limonitic ore, Hillcrest pit	0.834	0.818	0.016
Concretionary psilomelane	0.721	0.717	0.014
Banded amphibolite—magnetite slate	1.064	0.981	0.083
Pink ferruginous chert	0.081	0.066	0.015
Soft limonitic slate	0.893	0.887	0.006

Beneficiation of Phosphorus Ores

The two types of manganiferous iron ores on the Cuyuna range—that is, the high-phosphorus low-silica ores and the low-phosphorus high-silica ores—are used for two distinct purposes. The high-phosphorus ores are mixed with iron ore to increase the manganese content of basic pig iron and the low-phosphorus ores are used for making spiegeleisen. Experiments conducted at the Experiment Station of the Minnesota School of Mines indicate that it is impossible to remove sufficient phosphorous from the high-phosphorus ores by any mechanical process of beneficiation to make that type of ore available for the manufacture of spiegel.

Table V gives the average results of log washer tests of four samples of typical high-phosphorus ore. The iron and silica were decreased and the manganese and phosphorus increased.

The lenses of magnetite ore in the amphibole-magnetite slates of the South Range of the Cuyuna district give up their phosphorus by magnetic concentration, and Davis[9] has shown the possibility of making a very high-grade bessemer concentrate from the low-grade magnetite-bearing slates high in phosphorus. At present,

[8]Graham, William: *Econ. Geol.*, Vol. XX 319, 1925. (Summary of literature and experimental data.)

[9]Davis, E. W.: Minnesota School of Mines Experiment Station, Bull. 9, 1921.

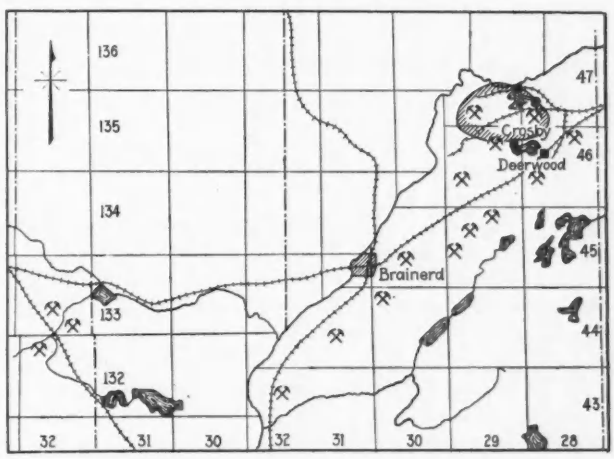


Fig. 4—Outline map of the Cuyuna Range, central Minnesota, showing localities (X) where igneous rocks high in apatite are intruded into the iron formation

The region of productive mines is included in the oval to the Northwest of Crosby

Table V—Average Results of Log Washer Tests on Four Samples of High-Phosphorus Manganiferous Ore

	Crude Ore Per Cent	Concentrate Per Cent	Tailing Per Cent
Iron	38.36	37.23	44.91
Manganese	14.43	17.32	6.91
Silica	11.28	7.95	19.94
Alumina	3.90	2.73	6.94
Phosphorus	0.140	0.150	0.115
Lime (CaO)	0.35	0.42	0.18
Magnesia (MgO)	0.18	0.17	0.22
Ignition loss	8.65	9.11	7.45
Ore by weight	100.00	72.21	27.79
Iron by weight	100.00	70.07	29.93
Manganese, by weight	100.00	86.69	13.31
Increase in manganese	.....	2.89	.....

however, the deposits of this type of ore are not of commercial importance.[10]

The phosphorus in the Cuyuna Range ores is erratic in distribution. Some of it may have been concentrated by the action of meteoric waters on the overlying Cretaceous sediments and on the neighboring basic igneous rocks high in apatite. However, the presence of apatite as an essential constituent of numerous veinlets and stringers cutting the iron-bearing formations, and the high-phosphorus content of the wall rock near many of the stringers, indicate that emanations high in phosphorus were given off from the basic magmas and deposited in the minute joints and fissures of the intruded sediments. Experimental data lead to the conclusion that meteoric waters aided in the redistribution of the phosphorus as the ores were concentrated.

In conclusion I wish to express my thanks to members of the U. S. Bureau of Mines, especially T. L. Joseph, for data on Cuyuna ores; to R. J. Leonard for numerous chemical analyses; also to Dr. W. H. Emmons and Dr. F. F. Grout for helpful suggestions and criticisms.

Foreign Developments in the Metallurgy of Zinc

The Waelz, Elmore, Coley, and Ashcroft Processes Look Promising —Arrangements Being Made to Check Results on a Commercial Scale

A. J. M. Sharpe, in his review of world zinc conditions on April 1, 1926, for the American Zinc Institute, gives the following information on the development of new processes for the treatment of zinc ores:

In no instance has finality been reached in the experiments except with the Waelz process, to operate which several plants are in course of erection, and in one case at least Waelz oxide, produced in Silesia, is being sold for reduction into metal. Information as to whether this method of treatment can be adapted to sulphide ores is not yet forthcoming.

One of the mining-finance houses interested in the Elmore process has announced that the commercial stage has been practically reached, and the results look so good that it is the intention not to issue licenses on royalty terms, but only to erect plants where ore producers are prepared to sell their concentrates outright or on a profit-sharing basis.

The Coley process is now controlled by a London financial group which has optioned the world rights and is completing the erection of a ten-ton-a-day plant at Stewarts & Lloyds' zinc smelter near Birmingham. The Coley plant consists of a rotary cylinder through which roasted ore is passed and subjected to a temperature of about 1,000 deg. C. and to certain reducing conditions. To obtain these conditions hydrocarbons, such as crude oil or powdered coal, are brought into contact with the heated ore, so that the hydrocarbons are cracked and, at the moment of cracking, release the carbon content in a nascent condition, with the result that the carbon effects the reduction. The zinc is recovered in vapor form and collected in bags for condensation. A recovery of 97 per cent or over of zinc is claimed, and, as working costs will obviously be low, the Coley process will have a wonderful future if its claims are substantiated by the working unit now approaching completion. So far as zinc is concerned, this process will either be a big thing or nothing.

The last process and one on which many shrewd judges are pinning their faith is that known as "New Metallurgy." This is a pyro-electrolytic-chloride system, and its inventor claims that it possesses many advantages over the hydro-electrolytic method of treatment in use today. In comparison with the latter, only half the electric energy is stated to be required, preliminary roasting or sintering is eliminated, fuel cost is negligible, and the labor cost low. Recoveries of 99 per cent of lead and zinc in even complex ores are claimed.

Briefly, this treatment consists of three operations:

1. Conversion in an apparatus resembling a small blast furnace, where, without the use of fuel or fluxes, the metal contents are converted into a slag or fluid melt of anhydrous chlorides at the low heat of 600 deg. C. by a continuous low-pressure stream of chlorine gas.

2. Precipitation. The melt is then agitated and, at a black heat of 500 deg. C., is transformed into a single fused anhydrous chloride of a "key" metal (usually zinc) by replacing the bases of all the other chlorides present by metallic zinc taken from (3) and stirred into the melt in granular form. The substituted metals are recovered in metallic and granular form, either singly or as alloys amenable to separation.

3. Electrolysis. In this third stage the zinc chloride is separated by decantation from the precipitated metals and is resolved into metallic zinc and free chlorine by a novel electrolytic process using a small compact apparatus with a multiple series of cells in a single container, the electrolyte being still in a state of fusion and at a black heat (475 deg. C.). The same chlorine is used over and over again.

"New Metallurgy" is the invention of Edgar A. Ashcroft, who based his work on the original discovery that lead and zinc sulphide ores are completely attacked by chlorine at 600 deg. C. with disengagement of elemental sulphur and that the resulting chlorides may be electrolyzed. The process has been proved out in a one-ton plant in England, and the world rights, excluding North and South America, have been optioned by a well-known English mining house, which is erecting a ten-ton plant to check the results on a commercial scale. Obviously, it will be many months before the demonstration plant has completed a full series of working tests.

[10] Thiel, George A.: "Commercial Possibilities of the Cuyuna Magnetite Slates." *Engineering and Mining Journal-Press*, Nov. 8, 1924.

Discussion

"Engineering and Mining Journal-Press" is not responsible for statements or opinions published under "Discussion." In many cases the views expressed are diametrically opposed to editorial policy and belief. Letters will not be printed unless the author's name and address are known to the editor.

For the Metric System

THE EDITOR:

Sir—In "Discussion" in the issue of March 26 appears the letter from Mark R. Lamb regarding the metric system as it is used or not used in South America, all of what Mr. Lamb says being true. This, however, is no case against the metric system.

After several years spent in South American countries I determined to my own satisfaction that the metric system would be a good thing for us to adopt in this country. Those countries all use some of the old Spanish measures such as varas, quintals, etc., but they are gradually being dropped. The legal system is the metric, and all packages that arrive there from foreign countries must be marked as to size and weight in the metric system. We may put on these packages our old-fashioned pounds and feet and inches, but the metric weights and measure must also be marked on the packages. Their railroads are all marked for distance in kilometers and the gages of many of them are so denoted. Practically all products of the country are denoted in the metric system as to weights and measures. It is only when the people have to do with material imported from this country or England that the metric system is not used. It is plainly seen that this is forced onto them.

The metric system is not compulsory in any of the South American countries that I know of, but that system is the legal one and the one used by the government. The people of those countries use feet and inches and pounds and buy lumber by the board feet because most of the material they buy comes from countries that are so benighted that they adhere to the old system. All French and German machinery that comes to those countries, that is of standard make, is built on the metric system.

I have been in the business of building machinery and in allied industries for nearly forty years and can see no reasons for such estimates of cost of the adopting of the metric system as are put out by the opponents of the system. There would be some cost to the manufacturer of machinery, but it would not come as an avalanche. It would be a gradual change. The modern manufacturer has no scruples about discarding old or obsolete designs, but he preserves the drawings and information so that he can supply repair parts for the obsolete machinery. The same system could be applied when the metric system is adopted.

I have read Mr. Halsey's book of arguments against the adoption of the metric system and think it is the poorest argument against it.

One of the first and most necessary things to do before the system is changed is to teach it in the schools and get the people to understand the system. When this is done there will be but little trouble to get Congress to adopt it legally. While the Britten bill is a step in the right direction it does not accomplish what is best in the least time.

I do not claim to be an adept in the use of the metric system, as it is not used in this country, but I can see where it can be used with the same facility in weights and measures as our decimal system of money is in making change or in computation. The metric system would show just the same improvement over our present system that our money system shows over that of England.

The decimal system with any unit as a base would be an improvement over our present system, but as long as so many other countries use the existing metric base it would be much more convenient for our exporters if we did the same.

The terms "world quart," "world pound" and others given in the recent publication of the Metric Association are clumsy and should not be adopted. Why not stick to the world terms that are now in use and that are nearly the same in Spanish, French, and English?

I have yet to find a valid argument against the adoption of the metric system except that of expense of making the change, and from my years of practical experience I should say that that argument was grossly exaggerated or magnified. J. A. THOMAS.

Los Angeles, Calif.

More About Western Lead

THE EDITOR:

Sir—I have read the letter from Prof. Bruce L. Clark, under the heading "Mining Makes Strange Bedfellows," in your issue dated March 13, in which Professor Clark repudiates his report on the property of the Western Lead Mines Co. Concerning the property, I have nothing to say, not having seen it, but I have a good deal to say concerning his letter and the joint report of Professor Clark and Ira Judson Coe. Professor Clark emphasizes the fact that he is not a mining engineer. Then why did he not stick to his last and leave it to his collaborator Mr. Coe to make the report? Some time early in February I was asked by a client what I thought of Western Lead. I replied that I had never heard of it, so he showed me C. C. Julian's advertisement and requested me to obtain information of same. The following day I called at Mr. Julian's offices, explaining who I was and asking if they would be kind enough to give me some information. I was immediately shown a copy of a report purporting to be signed by Prof. Bruce L. Clark and Ira Judson Coe. After carefully reading the report, which rather impressed me, and taking some notes, particularly of the amount of exploration done on the property, I duly reported my opinion to my client.

Last week my client called my attention to the letter appearing in your journal, and I naturally felt that I had been imposed upon, so I called at Mr. Julian's offices, stated my grievances, and showed them Professor Clark's repudiation. They in turn produced the

original report signed by Professor Clark and Mr. Coe and each page of same was duly initialed. In spite of the professor's repeated denial that he is not a mining engineer, the following is what he puts his signature to:

"In conclusion we wish to state that the formation is right for Lead Ores."

"The cause of the mineralization has been definitely established."

"There is a quantity of available ore exposed over a wide area."

"The ore is readily concentrated and large masses of shipping ore can be easily developed."

"We have no hesitancy in recommending the property for extensive development and the erection of a mill to concentrate the ores."

"Attached are topographical and geological maps together with photographs showing the structure and physical conditions."

Professor Clark seems to place the onus of writing the report upon Mr. Coe, but I would point out that the report is signed by both, the professor evidently being the senior consultant, and the pronoun "we" is used throughout the entire report.

It is common knowledge that the Corporation Commissioner has taken steps to investigate the matter, but I am free to state that from what I can gather Mr. Julian is perfectly within his rights in quoting the report of the engineers he has hired and paid, directly or indirectly, to examine and report upon his property.

From my personal knowledge of your sense of fair play, I feel sure that you will give my letter the same publicity that you have granted that of Professor Clark.

Los Angeles, Calif. J. OWEN JAMES.

Meteor Crater

THE EDITOR:

Sir—While reconnoitering in Arizona in the spring of 1907, hearing of Meteor Crater I hired a driver and buckboard and was driven there from the railroad. Going and coming and the necessity of returning before dark only allowed three hours on the ground—long enough to walk around the crater (I was not allowed in it) and to talk with the superintendent. From this trip I published an article "Meteor Crater," in the *Mining and Scientific Press* of April 10, 1909, with two illustrations. I then said, and I have not changed in opinion, "The shortness of the visit and my ignorance of literature on the subject made my impressions nearly valueless, but from casually examining many pieces of the silica, I thought it was the result of ascending hot waters, and that probably the pit was caused by the erosion of an underground stream, which, after its work in solfatarism, had carved for itself an outlet, and that the perpendicular circular walls resulted from a combination of faulting, causing the uplift and perpendicular jointing in harder rocks underlaid by softer. . . . This conception I find has been considered and discarded by capable men."

The article then contains a description of the crater and accompanying phenomena compiled from the various published articles. From the same sources I gave the geological column, from surface down, as follows: 30 ft. of red sandstone; 200 to 350 ft. of yellowish-gray calcareous sandstone called the Aubrey limestone, then 800 to 900 ft. of light gray, almost white, fine-grained sandstone, and under this a thin stratum of yellow sandstone, the thickness not definitely known. It seems, however, to be the uppermost member of the red sandstone beds which the U. S. Geological Survey says are 1,000 ft. thick. These sediments belong to the Grand Canyon series of the Carboniferous, and extend 70 miles in every direction, except where occasionally interrupted by volcanics, the nearest of which are 12 miles southeast. The illustrations show the faulting at the edge of the crater, which is claimed in an article as the result of an explosion. The samples I examined during the walk around the crater appeared to me to show the ordinary gradation from unaltered rock to altered, and I take it the 97½ per cent silica results from solution of soluble accompaniments, and that the key to the problem lies in a microscopic examination of complete suites of specimens, with present-day knowledge. Stress is laid on finding meteoric material under boulders from the crater. A detached rock weathers little in its comparatively rapid descent down a declivity and could pass over heavy fragments that would gradually sink in the hill dirt. J. B. HASTINGS.

Southgate, Calif.

The Practical Scientific Spirit

THE EDITOR:

Sir—It is a perfectly natural and expected result in metallurgy that certain concentrated "dry solutions" or "melts" will "replace" the furnace or other linings; in fact, many industries are constantly combating this tendency and studying how to overcome the "replacement" of "favorable" formations used by substitution of refractories. But in the case of deposition of ores, is it necessarily always "replacement"? Why not the removal of a "favorable" formation by the action of hot vapors or "attenuated solutions," *preceding* an "injection" or intrusion of an ore magma, the latter to be deposited in the spaces formed by the "removal" of the limestone or other "favorable" formation?

If the bedding of the limestone as shown in the geological section of the Tintic Standard mine (*Engineering and Mining Journal-Press*, Oct. 24, 1925, p. 646) is in accord with the facts, there is more than a hint that some beds at least were "displaced," as indicated by the lines of bedding (as sketched) and by the numerous minor faults which were evidently contemporaneous with the introduction of the ore. Furthermore, "The sedimentary rocks were covered by rhyolite flows before the mineralization, and the *outcrops of the fissures* show as iron-stained beds in the blue rhyolite." These "iron-stained" fissures at the surface suggest the escape of gases and "attenuated" solutions, during the initial stages of fissuring and rupture preceding the intrusion of the ore magma, carrying with them soluble iron, perhaps silver and other metal salts, together with the dissolved elements "removed" from the "favorable" formation. The gases, even before final rupture and release of pressure, might have contained "volatilized" metals! If man, in the course of his metallurgical processes, can accomplish the "volatilization" of the usual vein metals, it does not seem at all improbable that nature should take advantage of this physical characteristic and discharge some "flue dust" into the more superficial zones to be condensed upon final rupture and sudden release of pressure and drop in temperature. The shattering, crushing, and partial *disintegration* of the crystalline structure of any rocks affected would afford an excellent depository for the emanations whether via thin solutions or volatilization, and, in a "favorable formation," innumerable avenues for attack and "replacement."

In reviewing the reports by geologists of twenty years ago, the reader is continually confronted with the manifest effort to reconcile different sections of the same "lode" or deposits to the theories then current, only resulting in attempted complicated explanations.

Getting down to the simple facts that are recognized in connection with dikes; with operations in pyrometallurgy; and, elementarily, to the cake of artificial ice with its "vug" or "druse" (not solution cavity), lined with crystals from a "dry solution" (concentrated oxide of hydrogen), the student of the geology of ore deposits will advance more rapidly in the practical application of his science. LEVERETT S. ROPES.

Helena, Mont.

Mining Engineering and Prominence

THE EDITOR:

Sir—We mining engineers make me laugh. "Statesmen," "moralists" forsooth! For the first time in centuries we have a mining engineer-statesman, so we go about introducing ourselves "a mining engineer, like Hoover," so that the public will believe in us. We forget that while he was strictly a mining engineer—that is, a short-time slave working for a slave pay—Hoover was *only* a mining engineer, and it was only after he got into the owner class that we began to hear about him (along with his bankers).

A man who sticks as a mining engineer all his life, without making money in mines (operating, owning, selling to, building for, or trading in) is not worth writing this about. Mining engineering studies and practice are useful *only* as a basis for a financial success gained other than as a mining engineer. The very nature of "mining engineering" guarantees financial failure to its persistent followers. The more persistent and the older a mining engineer becomes, the less practical he is. If he is "consulting" he is more anxious about his "reputation" (God save the mark!) than he is about giving an investing inquirer a chance to make a mine. If he is managing, his jobs reach only from the beginning to the end of the mine, and each new job finds him less capable (say from sixty-nine on).

The first ten years' experience in general mining, if the changes are of average frequency, should prepare a student of life for any important task in it, and no mining engineer should remain one longer than that.

Buenos Aires, Argentina. MARK R. LAMB.

Uniform Mine-signal Code Needed

THE EDITOR:

Sir—It seems to me that every state should have the same mine-signal code, especially here in the West, where the miners are always on the move from one state to another, summer north and winter south. When a man works in one state for any length of time he gets to know the signals; then when he moves to another state he has to begin again and learn the signals for that state. Oftentimes he forgets himself and gives the engineer on top the wrong signal. Naturally in such cases the engineer does not know what move to make, or else makes the wrong move. Especially in sinking shafts the signals should always be correct. I believe a uniform mine signal law would prevent many accidents. PETER VUKOYE.

Kingman, Ariz.

Mining Investment

THE EDITOR:

Sir—A statement appeared in a recent issue of your journal that the average man gets a poor run for his money who tries to invest or speculate in mining and that one out of 200 gets his money back in the prospect stage. This is true, but no reason was given for cause of this condition, nor were any remedies offered.

Nine out of ten investors buy wildcat stock in preference to shares in a legitimate mine prospect or partially proven property. Why? The wildcat promoter or broker by misrepresentation of facts offers him immediate profit. This cannot be done by the legitimate operator. It takes time to open an orebody and more time to mine and turn ore into money.

The investor is largely to blame for his dense stupidity, buying without investigation. Stocks that will pay immediate profits and dividends are not for sale at bargain prices. But tons of literature and market letters are distributed weekly through the mails featuring these stocks as leading market issues. Who gets the investors' money on this class of stock? Roughly speaking, the broker and advertiser.

The average promoter or broker knows little or nothing about mining or ore reduction. A writer of wildcat copy told me he did not know a piece of ore from a doughnut, yet thousands of shares of stock are purchased on his recommendation of properties through market letters. The wildest flights of the imagination are used in enlarging an inch seam into a Comstock or Mohawk stope 50 ft. wide, and assays of spots of ore are advertised as placing property on a producing and dividend basis. Willful misrepresentation of fact is made with fraudulent intent. How so much of this stuff gets by Uncle Sam's postal inspectors is a mystery. Practical mining men, engineers, and operators would not put a dollar into these so-called mines.

The mining engineer renders a very poor service to the investing public. Qualified by years of training and experience, he should take the promoter's and broker's place in opening new properties, switching thousands of dollars from properties of questionable merit into legitimate mining enterprise. The dollar that goes into the wildcat does not produce a new dollar; it is profit only to the promoter and broker.

Something should be done in the way of federal legislation. Blue-sky laws do not stop the buying of wildcat stock. The only remedy is to stop the man who distributes them. The money derived from the sale of most mining stock becomes the personal property of the promoter. If a federal law required that 80 per cent of money raised had to be actually expended on properties, wildcatting would soon stop. There is plenty of money to finance all legitimate mining and industrial issues, if proper legislation were passed to stop the crook.

The legitimate mining company is forced to put out its own advertising matter and enter the brokerage business to raise development money. To use the expression of a large operator: "Mining has been prostituted with so many wildcat issues that the investor looks with suspicion on all offerings."

The rule of one out of 200 will still prevail unless the investor wakes up and demands something better than propaganda and wildcat copy for his money. It is up to him. T. F. BANIGAN.

Tonopah, Nev.

News of the Week

The Mining News of ENGINEERING AND MINING JOURNAL-PRESS is obtained exclusively from its own staff and correspondents, both in the United States and in foreign fields. If, under exceptional conditions, material emanating from other sources is published, due acknowledgment and credit will be accorded.

Summary

MOTHER LODE DISTRICT, California, still active; five major producing properties; mines over 4,000 ft. deep; annual payroll $2,000,000; county taxes heavy.

Dome mills lower-grade ore—Charters granted for two railways in Manitoba—Bingo Gold again in the limelight—Red Lake traffic heavy—Zinc deposits discovered in Gatineau district, Ontario.

Bolivian lead deposits being exploited—South African diamond production increased in 1925.

Mysore Gold decreases mining costs—Panama Gold to issue detailed statement soon.

Senate passes potash bill authorizing $550,000 per year for prospecting possible areas.

Star Mine, Burke, Idaho, ready to ship 4,000 tons of concentrate per month—Mine wages reduced 50c. per day—Atlas Tunnel advanced 551 ft. during March.

Leadfield promotion under fire by California State Corporation department; advertising methods questioned; Julian has not permitted inspection of his books and records.

Arizona Commission settles boarding-house strike—United Verde options Old Mammoth mine.

Auriferous conglomerate mined by hydraulicking in New Zealand; deposit contains 8d. per yard.

Pioche district, Nevada, ships sixty-seven cars in two weeks.

Consultation Page will appear Next Week

Coeur d'Alene Freight Rates to Portland Increased $1 per Ton, Effective May 1

The freight rate on zinc concentrate for export from points in the Coeur d'Alene district, Idaho, to Portland, Ore., has been advanced $1 per ton, effective May 1. In the early part of last year representatives of the Vieille-Montagne Zinc Co., of Belgium, visited the Coeur d'Alene district for the purpose of contracting for zinc concentrate. The success of their visit depended upon securing a satisfactory freight rate to the seaboard at Portland, there being several zinc producers, notably the Sullivan Mining Co., ready to sign up, as the terms offered by the Belgians were more attractive than could be obtained from domestic buyers. As a result of negotiation, the O.-W. R. & N. company (Union Pacific system) announced the following rates on zinc concentrate to Portland, effective until April 30, 1926: Concentrate valued at $30 per ton or under, $3.50; over $30 and not above $40, $3.75; over $40 and not above $50, $4; over $50 and not above $60, $4.25. A protest was filed by the railroad commissioner of Montana with the Interstate Commerce Commission, presumably on behalf of the Anaconda Copper Mining Co., against this rate, but without avail.

Shipments for export under contract with the Belgian company have been going forward during the last year by the Sullivan Mining Co. (Star mine), Highland-Surprise, Success, and Tamarack. As the freight rate to Portland would expire by limitation on April 30, the Public Utilities Commission of Idaho recently applied to the Union Pacific to continue the rate. However, the Anaconda company was again on hand with a protest, claiming that the Portland rate gave a foreign concern an unfair advantage over domestic zinc buyers, and also pointing out that the zinc industry in the Coeur d'Alenes had in great measure been developed by the Anaconda company. Evidently the showing made by Anaconda was effective, for announcement has been made by the railroad company that after April 30 the rate will advance $1 per ton. This increase will not effect Coeur d'Alene shippers for the present at least, for it is officially stated that the Vieille-Montagne company has agreed to absorb this increase.

Birch Lake Area, East of Red Lake, Attracts Attention

Many claims are being staked over a large region surrounding the Red Lake gold area, in the Patricia district of northern Ontario. The general trend of the favorable rock formation extends for many miles east and west of the original strike. Birch Lake, about 60 miles east of Red Lake, is at present the scene of considerable staking activity, and some encouraging samples have been brought out. Birch Lake, like Red Lake, has been recognized as a probable gold country for some years.

It is expected that by next autumn the whole territory from Rickaby Lake, on the Manitoba border, about 70 miles west of Red Lake, to some distance east of Birch Lake will be prospected. The mineralized formation at Birch Lake area covers about twice as much territory as that at Red Lake.

The boundaries of the Red Lake mining division will be extended so as to take in the Birch Lake area. It is reported that the Mining Recorder's office at Red Lake has been doing a heavy business.

Slocan Silver-lead and Zinc Mines Have Large Yield from Shallow Deposits

Since the early years of discovery some 270 properties in the Slocan mining district have, according to Dr. C. E. Cairnes, of the Geological Survey of Canada, shipped ore at one time or another. Of these, a maximum of 63 were actively producing in 1918, of which 27 shipped more than 100 tons each. The period of greatest production is represented by the years 1912 to 1919, inclusive, when the annual average production of silver-lead and zinc ores reached an estimated value of about $3,339,000. The ten years from 1915 to 1924 inclusive saw an aggregate production of 1,238,388 tons, valued at about $26,152,000. In 1924 shipments were made from 40 properties, of which 16 shipped over 100 tons. A total of 73,533 tons mined during this year had an estimated value of $1,481,719, represented by $662,331 for silver, $501,563 for lead, $309,784 for zinc, and $8,041 for gold content.

Most of the properties in the Slocan district, have paid their way from the start, for the reason that development began on high-grade silver-lead shoots outcropping at, or discovered within, a few feet of the surface. The tendency has been for these shoots to become zincky with depth and to persist to no great distance below the point of discovery. Development was not often carried far beyond pay ore, and, as a consequence, a great many of the properties closed down when the original discovery was worked out. In several instances, however, where the initial discovery provided unusually lucrative returns, development was continued to depths of 1,000 ft. or more, and im-

portant shoots, which otherwise would have escaped observation by more surficial explorations, were thereby discovered.

Future developments in the Slocan district are largely dependent upon other such discoveries at depth, as the surface has been carefully prospected and most of the outcropping orebodies have been worked out. As compared with the apparent continuity of some of the more prominent fissured zones in the Slocan, no property has yet been developed to anywhere near the exposed depth of such zones, which, in certain instances, have been traced over a vertical range of several thousand feet. Nor has the relief of the district any apparent direct relation to the mineral content of the orebodies, as equally rich silver-lead deposits have been found on the lower as well as on the higher slopes of the hills.

Within recent years there has arisen a greater desire on the part of mining companies to venture the expenditure of considerable capital in exploratory work at greater depths than heretofore, with the result that some very promising discoveries have been made. The high price of metals and the evolution of a successful milling process for the treatment of its complex ores have done much to encourage development in this direction in the Slocan.

J. G. B. Mining Co. Incorporates

George J. Bancroft, mining engineer, of Denver, Colo., has incorporated and financed the J. G. B. Mining Co. of Twin Lakes, Colo. (Leadville district). The company is incorporated for one million shares of no par value. No stock is offered for public sale. The holdings embrace Mr. Bancroft's Ten Broecke group, Sam E. Smith's Niagara group, and the mill, tramway, and equipment of the Buehler Mines Co.

What is known as the Broecke vein is one of the large veins of the state. It has been exposed for a distance of 4,500 ft. on the ground of the J. G. B. Mining Co., and probably extends much further. For considerable distances it is more than 20 ft. wide. Its ores contain lead, zinc, copper, gold, silver, platinum, and bismuth, named in the order of their importance.

The new company will continue the Niagara Tunnel several hundred feet along the vein, and then it plans to move the Buehler mill and tramway to a location where it can handle the ore from this tunnel. George J. Bancroft is president of the company, and J. G. Buehlen, of Brooklyn, N. Y., chairman of the board of directors. W. J. Kirsch, of Twin Lakes, is superintendent.

Alaska Juneau in March

During March, 1926, Alaska Juneau handled 306,100 tons, producing $143,000, or 46.72c. per ton, at an operating cost of $140,100, or 45.77c. per ton, and an operating profit of $2,900, or 0.95c. per ton. Other expenditures and accrued charges totaled $30,900, leaving a deficit for the month of $28,000. Additions to milling plant and Ebner preliminary work are reported to be 75 per cent completed.

Star Mine, Burke, Idaho, Soon to Produce 450 Tons Per Day or 4,000 Tons Concentrate Per Month

The Star mine, Burke, Idaho, will be producing ore at the rate of 450 tons a day, the capacity of the mill, by the middle of May. On this basis the shipping product will be around 4,000 tons of concentrate per month, of which 3,000 tons will be zinc and 1,000 lead. The zinc product is shipped under contract to the Vieille-Montagne company, Belgium, and the lead goes to the Bunker Hill smelter at Kellogg. This is the culmination of one of the most interesting mining enterprises in the history of the Coeur d'Alene district, and its success is a fine vindication of the management of the Hecla and the Bunker Hill & Sullivan mining companies, which own the Star on equal terms and operate it under the corporate name of the Sullivan Mining Co.

The Star property is west of the Morning and on the same vein. It is two miles south of the Hecla and on the opposite side of the high divide between Canyon Creek and the South Fork of the Coeur d'Alene River. The natural approach would be from the South Fork side, but owing to the already deep development of the Hecla mine and its excellent operating equipment, it was decided to enter and operate the Star through the Hecla. It was a daring decision, involving a large expenditure, intricate engineering problems, and possibilities that conditions might be encountered that would prove a barrier to the success of the enterprise.

The plan contemplated extending a crosscut south almost two miles to the Star vein, starting from the 2,000 level of the Hecla mine. To make a long and highly interesting story short, the crosscut was extended as planned and the Star ore-shoot found as anticipated, and it has since been developed to an extent that permits steady production. The crosscut passes beneath the summit of the divide at a maximum depth of 4,600 ft., and cuts the Star vein 4,000 ft. beneath its apex.

On the 4,000 level, which corresponds to the 2,000 level of the Hecla, the ore-shoot is 1,400 ft. long, extending east to the Morning end line, connecting with the Morning workings on the 2,250 level. A large tonnage has been developed by raising and opening up new levels, ore removed in this work providing about 200 tons a day, which is treated at the Star mill at Kellogg.

Pioche District Ships Sixty-seven Cars in Two Weeks

Ore shipments from the Pioche district of Nevada for the last two weeks have totaled 3,325 tons, distributed as follows: Combined Metals mine, 1,400 tons; Virginia Louise mine, 800 tons; Black Metals mine, 675 tons; and the Bristol Silver mines, 450 tons—a total of 67 carloads.

The Combined Metals mine is shipping its product to Bauer, Utah, where it is treated, and the production will be gradually raised to 200 tons daily. All work is now being done on the contract system, which seems to be working out satisfactorily under foreman A. M. Jensen, of Salt Lake City, Utah. The assay value of the product is gold, 0.04 oz.; silver, 5.9 oz.; lead, 6.2 per cent; zinc, 15.5 per cent; iron, 20.5 per cent.

The Bristol Silver Mines has the new power plant working well, and conditions underground are most satisfactory. Present production of 30 tons daily is being gradually increased as the ore recently struck is opened up. This ore assays 18.0 oz. in silver, 10.6 per cent lead, and 5.2 per cent copper.

The Fortuna mines, operated by Earl Godbe and Silas Thomas under lease, produced a carload of lead ore during the last month. Settlement was on a basis of 23.5 per cent lead and 18.9 oz. in silver.

Increased interest is being noted in the Comet district, and examinations of the Lyndon and Stella mines were made recently by mining engineers representing Salt Lake City and Los Angeles capital. The Comet district has produced $100,000 during the last ten years from small but rich deposits, the ore being taken out for the most part by leasers on the Stella and Lyndon mines.

Telephone Service One Mile Underground

The deepest telephone in the world was installed recently at the bottom of Tamarack No. 5 shaft of Calumet & Hecla Consolidated at Calumet, Mich. This equipment was placed in operation by the company's electrical department, assisted by employees of the Michigan Bell Telephone Co. The vertical shaft is 5,300 ft. deep. The connecting cable weighs almost four tons. It is anchored to shaft timbers with fasteners that support the weight and prevent the line from sagging or breaking.

Telephone communication with deep levels is not a new venture. Numerous telephones are in use in various shafts of the company's property, but the one in Tamarack No. 5 is the deepest. A pumpman working at the dam where water from the conglomerate and Osceola lode departments is drained into the bottom of No. 5 will be in position to report water conditions constantly, which will contribute much to the efficiency of the pumping system.

Arizona Industrial Commission Settles Boarding House Strike

The new industrial relations department of the Arizona Industrial Commission recently settled its first strike when differences between the management of the Katherine Gold mine and forty employees were arbitrated and adjusted. The mine is located 40 miles out of Kingman, Ariz. The employees walked out over a dispute about the food served at the company boarding house. J. C. Sanders, in charge of the industrial relations department of the commission, accompanied by Tom Foster, State Mine Inspector, went to Kingman and interviewed the management and the men. Differences of opinion were adjusted, and according to the commission both sides are satisfied.

Mother Lode District of California Still Active

Production Peak Reached in 1915—Five Major Properties Operating—Much Mexican Labor—County Taxation a Heavy Burden

By George J. Young
Associate Editor

THE Mother Lode mining district of California, comprising Amador, Calaveras, and Tuolumne counties, as well as several other less important counties, reached its peak production in recent years in 1915, when gold production for the three counties was $6,343,362 and ore production 1,487,296 tons. In 1924, gold production was $3,815,463, and ore and tailings handled totaled 680,637 tons. Complete 1925 statistics are not yet available. Since the war the gold industry in these counties has had a hard struggle, but the larger properties have by plant betterments and the practice of rigid economy improved their operating position to some extent. Curtailment of development as a result of war conditions left the principal properties in a relatively precarious position, but for the last few years development has been extended and deeper levels opened out, greatly improving conditions in the several properties.

Five major properties are producing, the Kennedy, the Argonaut, Central Eureka, Carson Hill, and the Plymouth. Of these, the Plymouth and the Carson Hill properties are in process of reorganization. Plymouth, in the hands of a receiver, was sold to the Argonaut Mining Co. by the London liquidator of the company prior to advertised sale under foreclosure proceedings in California. Upon the receipt of a deed from the liquidator, the Argonaut company paid all outstanding claims, and the receiver in foreclosure was discharged. Since the transfer of ownership, the mine has been rehabilitated and an operating program established. A production of 70 tons per day is being made, and sinking from the 4,300 to the 4,450 is under way. Present vertical depth of the mine is about 3,940 ft. The vertical shaft, 1,600 ft. in depth, connects with an incline shaft of 60 deg. slope. The new level, 4,450, will be at a vertical depth of about 4,070 ft. Exploration is being extended on several levels, and ore stopes are also being opened. A more economical milling practice is under investigation.

The Carson Hill is in process of reorganization of operating practices, after a change of management and several changes of superintendents. Production is from 300 to 350 tons per day. Plans are maturing for a change in milling practice involving finer primary crushing, automatic weighing and sampling, and, incidentally, the elimination of stamps and the use of corduroy blankets as finishing appliances after tables. The cyanide tailings plant and concentrate treatment plant will be continued under its existing arrangement. An interesting situation has arisen at this mine in conjunction with power and irrigation development. The Melones dam is under construction on the Stanislaus River below the settlement at Melones. According to present estimates, based upon a dam 210 ft. in height, the impounded waters will be backed up and flood the valley below Carson Hill in which are the mine workings. Certain parts of the present plant will have to be moved to higher positions. Just what effect the higher water levels will have upon mine drainage conditions cannot be forecast, but the mine management is endeavoring to have the height of the dam reduced 20 ft., which will avoid interference with present structures. As a result of the existing uncertainty plant improvements have been postponed until the situation has been adjusted. In the meantime the company is proceeding with development on present levels and has no immediate plan for opening deeper ones. Greater attention will be given to the Calavaras lode, which is an important vein system.

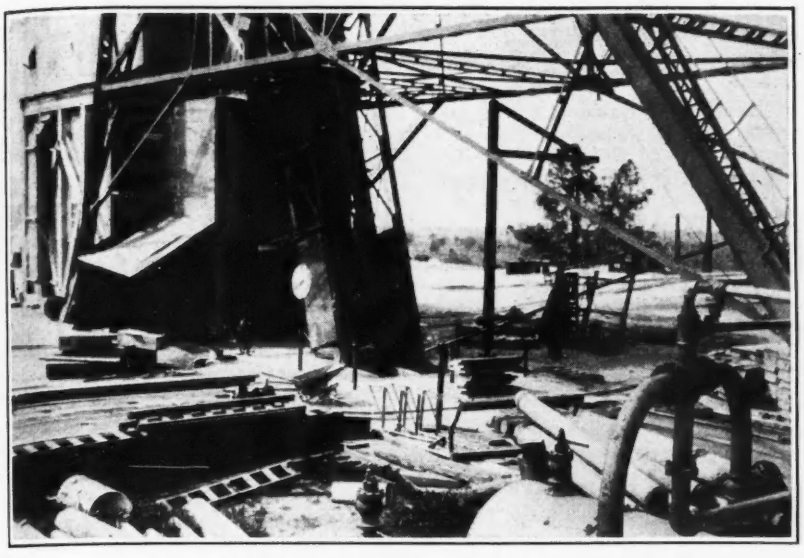
The Kennedy mine is operating sixty stamps and milling about 255 tons per day. Within the last three years two new levels, each 150 ft. in depth, have been developed, and sinking is in progress for another 150 ft. in depth, which will advance the vertical shaft to a depth of 4,612 ft. and open the 4,500 level. The 4,350 level developed a high-grade ore enrichment in good milling ore. The Kennedy has been fighting down operating costs. A storage-battery locomotive is to be installed on the 4,350 level and plans have been made to change the present steam hoist to an electric motor drive with a depth capacity of 5,000 ft., but this change is predicated on the results of development. Few or no changes have been made in the milling plant other than those required by mechanical maintenance. Present plans also contemplate the erection of a steel headframe, installation of increased air compressor equipment, and the electrification of the north shaft hoist.

The Kennedy and Argonaut mines have completed a permanent connection between both mines on one of their lower levels. A refuge chamber has been provided in an enlargement of the connection, which is on the 4,600 level of the Argonaut and the 3,900 level of the Kennedy mine. The refuge chamber is provided with iron doors set in concrete frames, compressed-air pipes, and telephones.

Central Eureka, at Sutter Creek, is milling at the rate of 170 tons per day, the lowest level at present being the 4,500, which is about 4,229 ft. in vertical depth. Sinking is under way, and a new level is to be opened out about 150 ft. below the last level. High-grade ore has been struck on the 4,500 level, and ore grades as a consequence have been considerably increased of late. Preparations are being made to unwater the old Eureka shaft. The property was purchased later by the Central Eureka company, and further exploration is to be attempted.

The shaft of the Argonaut mine has been deepened to the 5,350 level and the 5,250 station is now being opened. The shaft is 5,350 ft. on the incline, or 4,672.32 ft. vertically from collar to sump. It is the deepest shaft on the Mother Lodge, the present bottom being about 3,172 ft. below sea level. The lower part of the shaft passes into the hanging wall of the vein and crosscuts are extended westerly to the vein. The vein at the 4,950 level was considerably faulted and not as wide nor of as good grade ore as on the 4,800 level. On the 5,100 level the vein was narrower than on the 4,950, but was of better grade. The footwall of the vein flattened from levels 4,800 to 5,100. Although ore grades vary, no barren zone has been struck. As an example of the variation in the vein width, which averages 12 ft. on the 5,100 level, the vein reached a maximum of 60 ft. on the 4,800 level, which has produced 182,000 tons of ore. Heavy stoping ground in the lower levels required a change in mining methods, resulting in the development of a method which is new in the district. A stope is started from a two-compartment raise, connecting levels, by carrying down, from the upper level, a vertical slice alongside the raise, timbering this with "butt caps" (horizontal stulls) set in hitches in both walls and temporarily supported by booms extending from the raise. The length of slice along the strike is about 5 ft., allowing for 4-ft. center spacing of stulls. Drilling is done by hand-held drills, and the ore is broken to the raise compartment, which serves as a transfer to the lower level. A second vertical slice is carried down on the completion of the first, and when this is completed the raise compartment is lagged and the raise filled with waste, the manway compartment being stripped of ladders and pipes, which are transferred to the first vertical stoping slice. The stope is carried along the strike by successive pairs of vertical slices. Vertical timbers are used between stulls. Ore is broken from the footwall to the hanging wall. The method has obvious advantages and avoids undercutting any considerable area of vein. The mine production is 260 tons per day, which supplies a sixty-stamp mill. Tailings are re-treated in a custom plant.

The Shawmut mine, which was at one time an important producer, is now to be definitely abandoned. South of the Shawmut, the Clio mine is being developed and increased milling capac-



Central Eureka mine, near Sutter Creek, Calif.

ity is being installed. At the Moore mine, near Jackson, shaft sinking has been completed to the 1,850 level, and exploration is in progress on the 1,800, 640-south, and 1,100-north levels. The shaft is an incline varying from 52 to 60 deg. in slope. The oreshoot on the 1,100 and upper levels is faulted, and subsequent work has been directed to finding its continuation on the upper levels and sinking to open a lower level. A large area of promising ground is now under control of the company. Near San Andreas, the Washington mine has reached a depth of 580 ft., and an increase of the mill to twenty stamps is under construction. About forty tons per day is being produced.

Jackass Hill, in the Mother Lode area of California, southeast of Carson Hill, is to be explored. A tract of 230 acres has been purchased by the Bell Mining Co. and the Victor Gold Mines Co., which, it is said, will reopen the old Victor mine. The area is in Tuolumne County, north of Tuttletown. H. A. Morse is in charge of the new work, which is to be started in the near future by equipping the Bell and Victor properties.

At Copperopolis, which is west of the Mother Lode region, the Calaveras Copper Co. is operating steadily and producing 400 tons of ore per day. The lowest level is the 1,450, which was developed last year. The ore is treated by flotation, the concentrates being desulphurized on Dwight-Lloyd sintering machines and smelted in a small reverberatory furnace. Copper matte is converted and the blister copper shipped to the Tacoma smelter. Copper production is about 600,000 lb. per month. Northwest of Copperopolis the old Wilbur mine has been reopend and some production is being made.

Two gold dredges are operated in the region west of the Mother Lode. One is the Jenny Lind, on the Calaveras River, which is one of the oldest gold-dredging fields in California. The other is on the Tuolumne River near La Grange. Both dredges have been in operation for several years.

On the Mariposa Grant, the southern end of the Mother Lode, the Princeton Mining Co. is sinking a new shaft east of the old Princeton shaft and has attained a depth of 700 ft. It is planned to sink to the 1,000-ft. level before crosscutting. Three or four of the old mines are being operated by leasers. In all, about fifty men are at work. No little excitement was caused by the discovery of good-grade ore in the serpentine belt east of the Mother Lode veins.

At Clearing House, on the Merced River, the Original Mining & Milling Co. is operating a small mine, which has been worked for the last seven years. Total production to date is $1,203,441. During 1925, 11,094 tons was milled, yielding a gross value of $167,642, or $15.11 per ton, the average head value being $16.95. Over a seven-year period the value recovered averaged $13.58 per ton. During 1925, a new level, the 1,100, was opened out, and the orebodies, although separated by a fault, were found. Development on the 950 level also disclosed ore shoots.

Labor Conditions

On the five principal Mother Lode mines, Kennedy, Argonaut, Central Eureka, Carson Hill, and Plymouth, about 900 men are now employed and about 1,000 tons of ore per day are being mined. Of the smaller properties, the Moore, Original Mining & Milling, Clio, Mariposa Grant, and Washington, about 200 men are employed and about 200 tons of ore per day are being mined. Including Copperopolis, the estimated total number of men is 1,450 and the aggregate daily tonnage about 1,600 tons. The aggregate annual payroll is in excess of $2,000,000.

Labor conditions in so far as supply is concerned are good, but a large proportion of the available labor is Mexican and many of the workers are not especially skilled in mining. As a consequence, operating efficiency is not as good as it was formerly, but some improvement is being made by a more careful selection of miners. At one mine 90 per cent of the underground labor is Mexican and at another 40 per cent. Apparently this conditions is to continue.

County Taxes

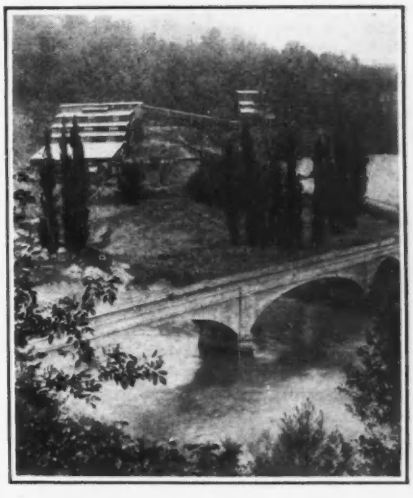
County taxation is in most instances burdensome to the mines, which are at the whim of the county assessors. The operation of the King Act has resulted in converting the mines into the principal taxable industry upon which the counties can levy. Greater economy in county administration is needed, and the combination of the four Mother Lode counties, Amador, Calaveras, Tuolumne, and Mariposa, into one county would materially relieve the situation. The presence of good roads and rapid transportation have changed conditions from what they were in the days of the "hay burners," and there is no special justification for the maintenance of four county governments for an aggregate population of 24,519. Another growing burden upon the mining industry is the increase in industrial accident compensation charges, which appear to be excessive.

Guggenheim Interests Reported to Have Taken Over Claims Near Prescott

The American Smelting & Refining Co. is reported to have taken over a lease on the old Amazon group of claims about 18 miles east of Wickenburg, Ariz., and has already begun active development work. The claims are known among mining men of early days as the Robert Groom group. Several months ago a lease on the property was given to another company that worked it a short time.

Co-operative Mine to Start Mill Soon

The Co-operative Mine, Lordsburg, N. Mex., recently completed sinking its shaft an additional 200 ft., making the total depth 800 ft. Over 600 ft. of drifting has been accomplished in the last few months, and it is reported that considerable high-grade shipping ore has been opened up. The mill is completed, and milling operations are to be started at an early date. H. C. Walters is manager.



Milling plant, Carson Hill mine

News From Washington

By PAUL WOOTON
Special Correspondent

Senate Passes Potash Bill—Opposition Expected in House—Seven Million Acres Withdrawn from Entry

THE Senate on April 14 passed the bill proposing an appropriation of $550,000 for the next fiscal year, and a similar amount for each succeeding fiscal year for four years, to provide for an effort to determine the location and extent of potash deposits or occurrences in the United States. Following this action a large area in New Mexico was withdrawn from entry.

Under the terms of this bill the work is to be undertaken by the U. S. Geological Survey and the Bureau of Soils. A condition of the bill is that before undertaking drilling operations a contract must be made with the land owners or those holding the mineral rights, under which the United States will be reimbursed for the cost of exploration, provided potash is found in commercial amounts or minerals are developed enhancing the value of the property. Owners of properties within a radius of ten miles also must enter into an agreement to observe a maximum fair price, which the Secretary of the Interior will fix, in the event of the discovery of commercial deposits. In view of the increased value of their lands as a result of government prospecting, they also are required to agree to pay 10 per cent of their net profit on any potash they may produce until the government will have been reimbursed for its exploration costs.

The bill is expected to receive the approval of the House Committee on Mines and Mining, but the leaders in the House are said to be opposed to the measure, and it is doubtful if it can become a law in the face of that opposition. The leaders are thought to be influenced principally by the large expenditure which the bill authorizes. They also feel that the prospecting should be undertaken by private enterprise, in view of the favorable reports on the geology and the frequency with which potash strata have been encountered in the course of oil well drilling.

On the other hand, it is argued that before private industry can be induced to undertake extensive exploration, provision would have to be made in the tariff law for protection in the event potash were found in commercial quantities. It is argued that even were deposits found which are comparable in extent and quality to those of Germany it would be many years before production could be accomplished at costs approximating those of Germany. The Germans, it is claimed, if forced to do so, could reduce the present low cost of potash by 35 per cent.

Those in favor of government exploration contend that there is no need to burden agriculture with the increased prices which would result from tariff during the exploratory period. If the government undertakes the work, there would be no need for a tariff, and at the same time the knowledge that an intensive search is being made would tend to keep prices at the present low level.

The statement also was made that the German-French potash industry is divided as to policy. Those in control at present favor the sale of the product at comparatively low prices, with the idea of stimulating demand. Another element within the combine advocates the taking of the maximum profit while the opportunity exists. There is no telling, they indicate, when this latter group may attain the ascendency. They believe that $550,000 per year for five years is nothing more than business insurance which the American people can afford to pay.

Senator Smoot made this statement to the appropriations committee of the Senate:

"The largest deposit of potash I know in America is east of Marysvale, Utah. It is not as rich as the German and French deposits, but we have worked it for years. The mills are there. During the war they worked, but they cannot compete with French and German potash. If we had a small duty on it, those operations could be continued. We could obtain potash also from the waters of Salt Lake. Two plants operated there during the war. If we put a tariff on potash that would settle the question."

In the meantime, the government has withdrawn 7,000,000 acres of public land in the so-called potash area of New Mexico.

Zinc Deposits Discovered 100 Miles North of Ottawa

Within the last few days there has been reported at Maniwaki, in the Gatineau district, about 100 miles north of Ottawa, Canada, the discovery of a zinc sulphide deposit, the ore of which bears a high percentage of zinc and copper as well as traces of gold and silver. Samples have been taken from the surface and large quantities of ore have been uncovered. A number of pits have been sunk to a depth of 10 ft., which have disclosed a vein of some hundreds of feet long.

Analysis of ore from this mine gives the following figures: Zinc, 16.05 per cent; copper, 10 per cent; silver, 12 oz. per ton; gold, traces. The zinc deposit compares favorably with the deposit reported from Noranda.

Iowa-Tiger Properties Under Lease and Option

The Iowa-Tiger mining properties, at Silverton, Colo., have been taken under lease and option by the Colorado-Mexico Mining Co., recently organized. Officers of the company are R. P. Ralston, president, and G. R. De Beque, vice-president and manager. The Melville mine, one of the principal mines of the group, will be unwatered. If examination proves satisfactory the orebody will be developed, and the old Iowa mill, of 150 tons' capacity, repaired.

There is no public offering of stock. Money necessary for mine development and repair of mill and tramways is being subscribed by a small group of men. It will be paid into the treasury and used for that purpose, after the organizers of the company have unwatered the Melville mine and proven the existence of ore.

Pumping machinery has been shipped to Silverton, and men are now at work repairing the tramway so that the machinery can be taken from the railroad to the mine. The Iowa-Tiger mines have a smelter record of about five million dollars net value. The ore from the Melville is lead-silver-copper. That from the Iowa mine is lead-zinc, with silver and gold values.

Miner's Wages Follow Drop in Lead Prices

The wage bonus paid mine employees of the Coeur d'Alene region, Idaho, was reduced 50c. a day on April 1. The miner's wage is based on $3.75 a day plus the bonus, which is governed by the price of lead. The bonus was $2 until the lead price was reduced.

Atlas Advances Tunnel 551 Ft. During March

During March, 1926, the Atlas Mining Co., of which W. Earl Greenough, of Wallace, Idaho, is manager, operating at Murray, Idaho, has advanced the long crosscut tunnel 551 ft. This crosscut is being extended through the St. Regis formation, its dimensions being 8x10 ft. At the end of the month the face was 3,302 ft. from the portal. The work is being done under the direction of James P. Cogswell, who distinguished himself a few years ago by advancing the Armstead tunnel, at Talache, Idaho, 544 ft. in one month, a record he has now excelled at the Atlas. This achievement establishes a record for Idaho. Excluding the superintendent, twenty men were employed, working three shifts with six men on a shift and two men employed outside. The muck was handled by hand and trammed by mule power. An average of 18 feet a day was made.

The highest record heretofore made in the Cœur d'Alene district was in May, 1924, in the Star crosscut, when an advance of 421.4 ft. was made. The crosscut was 8x8 ft., driven in Revett quartzite. Three shifts were worked, and on each shift there were three miners, one mucking machine operator, one helper, and one motorman.

Regulations Relating to Mines—Article 27 of the Mexican Law

THE following rulings and regulations were published in the Mexican "Diario Official" No. 25, March 29, 1926, all of which have a special bearing on the mining industry in Mexico.

Art. 2—All notaries, judges acting as notary public, Mexican consuls in foreign countries, and any and all officials having any intervention of whatsoever kind, in the execution of documents shall take care that in all articles of incorporation of Mexican companies, . . . for the exploitation of mines, water and combustible minerals within the Mexican Republic, it be expressly stipulated that any and all foreignors, that at the time of the execution of articles of incorporation or any time thereafter, acquire any interests or participation in the corporation shall be considered by that very fact as Mexican citizens, and it will be understood that said foreigner or foreigners shall never ask the protection of his or their government under the penalty of losing said interest or participation to the benefit of the nation.

Art. 4—When the company is a corporation, besides all requisites established by Article 179 of the Commercial Code, its shares shall have an express clause, to which Article 2 above refers, which clause shall be printed or engraved in the respective titles or certificates of shares for the purpose that whoever acquires them, it is with the understanding that, by the mere fact of their acquisition, accepts the covenant referred to in Art. 2 of the present regulations.

Art. 5—All Mexican corporations already extant, that have the domain of lands, waters and their accessories, or concessions for the exploitation of mines, waters and combustible minerals within the Mexican Republic, are obliged, in case of transfer of shares or participation to foreigners, to adopt as a principal part of their articles of incorporation or by-laws, the clause referred to by Art. 2, with all requirements. The same corporations in cases of new stock issues, whether it be in exchange for the primitive stock or because of the increase in their capital stock or for any other reason whatsoever, shall take care to print in said certificates of shares the clause above referred to.

Art. 6—All Mexican companies extant that have or may have foreigners as shareholders, and that in the future acquire or propose to acquire the domain of lands, waters and their accessories, concessions for the exploitations of mines, waters and combustible minerals within the Mexican Republic shall comply with all the dispositions contained in the above article, applying to the Department of Foreign Affairs for the respective permission.

United Verde Copper Co. Options Old Mammoth Mine

The United Verde Copper Co. has taken a ninety-day option on the old Mammoth lead molybdate mine, the Mohawk and the Collins mines, at Schulze, 52 miles north of Tucson, Ariz. The option price is said to be $750,000. A number of engineers and samplers are making a thorough examination of the property under the direction of Louis Reber, chief engineer of the United Verde company. The property can be reached by automobile from Tucson or Winkelman.

The purchasers of the mines are to sink the present Mammoth shaft from the 850 level to the 1,100 level and to do a certain amount of drifting along the vein on that level. During the 70's and early 80's the Mammoth was one of the important mining centers.

Keweenaw Copper Assets in Excess of $4,000,000

The annual report of the Keweenaw Copper Co., Calumet, Mich., shows assets of $4,321,631, of which $42,729 is cash. Revenue in 1925, including interest and dividends, was $42,991. All assets and properties of Phœnix Consolidated and the Meadow Mining Co. were purchased by the Keweenaw Copper Co. upon the dissolution of those companies. Similar proceedings with reference to the Washington Copper Co. and the Humboldt Copper Co. are pending.

Julian Leadfield Promotion Under Fire

In a recent action in Los Angeles courts initiated by C. C. Julian against the State Corporation Department of California and the *Los Angeles Times*, in which Julian accuses both of conspiracy, the promotion of Western Lead Mines is being reviewed by the court. The *Los Angeles Times* in its answer to the Julian complaint sets out various circumstances which came to the attention of the *Times* and which cast doubt upon the merit of the enterprise, among these being certain articles in the *Engineering and Mining Journal-Press* which challenged the advertising statements made by Julian. Another was a report of the engineer of the State Corporation Department which classed the Western Lead as an undeveloped prospect with very little ore in sight. In view of these facts the *Times* suspended publication of the Julian advertising and denies the conspiracy charge.

Governor Richardson has had the state mineralogist, Lloyd L. Root, examine the mineral claims, but although Root was a witness in the proceedings his report to the Governor has not yet been issued. Julian demanded that the books and records of the Corporation Department concerning the investigation of Western Lead be thrown open for the inspection of all interested parties, but to date Julian has not permitted the books of the Western Lead to be inspected. Various individuals were examined, among these Letson Balliet and J. W. Brandhauer. Balliet testified that he believed that there is an enormous quantity of lead-silver ore in the Western Lead claims, but on cross-examination admitted that he has no basis on which to estimate the amount of ore. He denied that he had made a report on the district to the Tonopah and Tidewater Railroad and to the Union Pacific Railroad. Brandhauer, who testified that during a two-day examination of Western Lead claims he saw the largest surface showing of lead ore in his experience, admitted on cross-examination that he is not a graduate engineer and that his estimates were partly guesswork.

On the following day Prof. Bruce L. Clark, of the University of California, testified that there were certain exaggerations and inaccuracies in Julian's advertising in connection with the sale of Western Lead stock. He denied that he was one of the six leading geologists of the country, as asserted by Julian. He stated that Julian had misused part of a joint report of Clark and Coe that was used in advertising. He denied that he wrote about the extent of the lead deposit which was attributed to him in the advertisement. Coe, the next witness, substantiated Clark's testimony. Coe testified that he is of the opinion that there is a block of galena-bearing limestone 2,000 ft. square and 400 to 500 ft. high, but was unable to state how much lead ore is in the block. He is a civil engineer. J. K. Turner, another witness called by Julian, testified that the claims are good prospects worth developing, and, after admitting that he is not a graduate engineer, said that there was no ore in sight when he inspected the claims.

The Tonopah and Tidewater Railroad Co. has issued a public denial of connection with any report on the Leadfield district. The denial is as follows:

"**Notice to Public**—We have had no report on the Leadfield district or mines made by any engineer or geologist nor endorsed any such report made voluntarily to us, and any information or inference to the contrary being circulated through ads, publications, or statements is entirely without foundation or our authorization."

Hollinger Installs 2,000 Horsepower Hoist

The Hollinger Consolidated, of Porcupine, northern Ontario, has installed and put into operation at the Central shaft the largest hoist ever installed at any mine in Canada. It is operated by a 2,000 hp. motor at a speed of nearly 3,000 ft. per minute. The Central shaft will be equipped with facilities capable of drawing 12,000 tons of ore daily before the middle of this year. The hoists will be operated an average of sixteen hours out of each twenty-four. It is planned to install another shaft of about the same size before the end of May. The mill is now handling 5,700 to 6,000 tons of ore daily.

Toronto Letter

By Our Special Correspondent for Northern Ontario

Dome Mills Lower-Grade Ore—Two Railway Charters Granted in Manitoba

Dome production in March was $344,933 from 46,999 tons, an average of $7.34 a ton. This was an increase in output of $15,000 over the record of the preceding month, but the average grade is 20c. lower. The tonnage treated established a new high record.

Since the annual meeting of the Dome Mines, held in Toronto, the impression seemed to be that General Manager De Pencier was somewhat overpessimistic and that President Bache's statements were an effort to counteract this. Mr. De Pencier stated that the new orebodies at depth were smaller than those on the upper levels and that he was depleting the mine, as he was milling more than was being put in sight, and that there was a decline in the grade of the ore. Mr. Bache said the results were not as bad as appeared on the surface; costs had to go up on account of the extensive development, but that there were a good many undeveloped places still left in the mine, in which big discoveries might be made. He stated further that the dividend was not in any jeopardy; the mine was only running a little behind the dividend requirements and the dividend assurance fund of over $2,000,000 was expressly for the purpose of meeting any deficit. Asked if this dividend assurance fund could be used for other purposes, Mr. Bache said that this was a legal question, but that if there was any such necessity the matter would first be brought before the shareholders. This, however, was looking at least eighteen months ahead.

Red Lake Property May Be Valuable Asset

In all the talk about Dome, sufficient importance does not seem to be given to the Red Lake holdings of the company and the effect that they might have upon the future. Though it would of course be unwise to place too much reliance on what the Red Lake properties may amount to, the fact should not be overlooked that all the engineers who have visited the district are optimistic and there have been no criticisms. All the conditions — geology, size of veins, and value of ore—are extremely favorable. The next few months should go far to proving the property, when the three diamond drills now being set up begin to give results.

Red Lake Traffic Heavy

Traffic into the Red Lake district is still heavy; planes are running from both Hudson and Sioux Lookout, 12 miles to the west. All supplies for the Dome and McIntyre have reached Red Lake in time to relieve any food shortage. Food was scarce immediately before the arrival of the new supplies, but there is now plenty to last until well after the break-up. It is estimated that there are approximately 500 men in the Red Lake district, and to date more than 3,000 claims have been staked. The little town of Hudson, which a few months ago had a population of nineteen, now has a population of over 300, and plans are being made for greatly enlarged population. There will be plenty of transport after the break-up, as there will be a regular mosquito fleet of fast motor boats to Red Lake. The Hudson's Bay Co. and Revillon Frères will have seventy scows in commission for the transport of freight. The Ontario police are active at Hudson, and will not allow people to go into the district unless they are properly equipped. Some arrivals from the southern states were preparing to go in over the 160 mile trail with low shoes, silk socks, and other inappropriate clothing carried in a suitcase.

Charters Granted for Two Manitoba Railways

A few days ago charters for two railways were granted by the Manitoba Legislature. One of these was granted to interests connected with the Spanish River Pulp & Paper Co., which desires to build a line through the Central mining fields to the Ontario boundary; the other charter granted was to the Winnipeg Electric Company for a line through much the same area, only extending through the Red Lake field and on to Hudson's Bay. Government support will be given to the first company which shows serious intentions of proceeding with the work. The C. P. R. also has three survey parties in the field, but as this company holds a Dominion charter, it is not necessary for it to receive Provincial sanction in order to make extensions.

Two New Gold Mills

It is announced that the Sylvanite Gold Mines, which lies between the Wright-Hargreaves and the Tough-Oakes, Kirkland Lake, will build a 200-ton mill. The property is controlled by Buffalo interests, who have been quietly developing for some time.

The latest new gold mill to start operations is the Paymaster, in Porcupine. The mill has a capacity of 125 tons a day, and it is expected that heads will be about $6. The manager states that it is believed the mill can be operated with only two men on a shift. By July it is expected that the capacity will be enlarged to 350 tons a day, by the installation of another tube mill and extra filter capacity.

Bingo Gold Mines

A great deal of interest is being displayed in Winnipeg over the trial of Joseph Myers, in connection with the Bingo Gold Mines case, and there is considerable resentment over the way it is being conducted. The resources of the law, instead of being utilized to get at the bottom of this case, are apparently being used to prevent any important disclosures coming to light. Evidence of mining engineers who sampled the property will not be admitted, because they did not sample in exactly the same spot as previous samples were taken. The Bingo is one of the worst fiascos in the recent history of mining in this country, and it is unfortunate that every effort should not be made to learn the truth.

Melbourne Letter

By Peter G. Tait

Special Correspondent

Auriferous Conglomerate Mined by Hydraulicking

Melbourne, March 16—A paper read at the recent mining conference by W. R. Smyth, mine manager, describes a huge deposit, or series of deposits, of auriferous conglomerate or "cement" near the railway between Milton and Lawrence, south of Dunedin, N. Z. This material has every appearance of having been originally a river gravel, the pebbles being well water-worn. It is singularly free from stones of more than nine inches in diameter. The pebbles are firmly bound together by sand or fine-grained detritus, and the presence of some cementing medium has, speaking generally, caused it to set relatively hard, thus justifying the miners' term "cement," which has been applied to the whole deposit. A certain amount of pyrite exists throughout this mass of material, being more abundant at the "bottom" or lowest stratum, lying on the schist rock. "In some places," states the author, "a 'fall' of cement when brought down will, in the process of falling, resolve itself into a loose mass of shingle, while in others the falling, however forceful, will fail to reduce it below the size of what might be called large blocks. Where these hard 'areas' occur, much explosive and manual labor are required to reduce the cement to such a condition as will admit of even a portion of its gold content being recovered by the usual alluvial system of treatment."

Deposit Runs 8d. per Cubic Yard

The Blue Spur deposit is reliably estimated to contain gold to the value of not less than 8d. per cubic yard. Much of it has given a return of several shillings per cubic yard. "It is probable," continues the author, "that the gold content of these vast bodies of cement that yet await development and treatment is much greater in quantity than the amount actually won from the alluvial gravels and cement deposits of this locality during the years that have elapsed since their discovery by Gabriel Read in the year 1861. With a view to the elimination, as far as possible, of the costly item, explosives, the Golden Crescent Co. at Wetherstones, constructed a high-pressure pipe-line into which the water was dropped from the open race at such an elevation as admitted of the water being delivered at the nozzles under a pressure of 300 lb. to the square inch. Under this pressure a powerful jet of water, when intelligently directed, proved itself to be a most effective agency for the breaking down of the material directly from the cement face, and for its subsequent pulverization.

"This last method of treatment by water under high pressure represents the best achievement and the most advanced point yet reached in the way of dealing with the cement in the mass for the extraction of its gold content."

London Letter

By W. A. Doman

Special Correspondent

Mysore Gold Decreases Mining Costs—Ashanti Obtains 90 per Cent Extraction

London, April 6.—During 1925 the Mysore Gold Mining Co. milled 232,137 tons of ore and produced 107,520 oz. of fine gold, and re-treated 379,437 tons of sand and slime for 17,847 oz., the amount realized being £541,686, against £589,344 in 1924. Less was obtained for the gold, owing to the disappearance of the premium. The total costs per ton were 24s. 4d. in comparison with 26s. 7d., the decreases being effected in mining, upkeep of machinery and plant, and development, notwithstanding that the mine has reached a greater depth. Ore reserves are 15,111 tons lower, at 602,960 tons.

The Murex company, whose process is being used at the Mawchi Tin & Wolfram Mines, is reorganizing its capital to make provision for the repayment of, or a considerable reduction in, the loan by the bank and for other liabilities and to furnish the company with working capital.

A good deal of attention is being paid at the moment to manganese, and, judging by a cable dispatch received from Johannesburg, the Edmund Davis group, which has such a large interest in manganese in Africa, will have to meet some formidable competition in the event of the estimates proving correct. It is stated that a deposit of manganese ore is traceable 40 miles northward from Postmasburg, in the Cape Province. The deposit contains 42.58 per cent of metallic manganese, no phosphorus, and small amounts of silica and iron. The deposit is estimated to have a depth of 100 ft., and according to the experts more than 20,000,000 long tons are available.

The report of the Ashanti Goldfields Corporation for the twelve months ended Sept. 30 last is now available, and contains, from the technical standpoint, some interesting items. Of the development of 3,968 ft. in the Ashanti mine, 674 ft. were done on the extension and enlargement of the main ventilation shaft. Now that the reconditioning of the hoist at the main shaft is complete, "haulage troubles" are for the time being over. The sand pass from the surface, which supplies filling for the stopes, must be deepened, and later some arrangement will have to be made to transfer the sand to the north end of the mine to meet the changed conditions brought about by the pitch of the oreshoot.

"Wet" crushing was finally abandoned in November, 1924. The results for the last ten months of the year—since all-roasting was completely re-established — show a percentage of actual extraction of 89.8 (close to the theoretical extraction of 90.2 per cent), though in October it was 92.1 per cent. This extraction, though much better than that obtained during the last few years by the "wet" crushing methods, is not so good as was formerly recorded for this plant by the old dry crushing and roasting method, when about 93 per cent extraction was achieved over several years. It is thought possible, by closer attention to the mixing of the "fines" and to details of cyanidation, and by adding a further Hum-mer screen, to improve still more upon recent extraction results. Steps have been taken to replace wood fuel by the use of pulverized coal.

Panama Gold to Issue Statement

Since my last mention of the Panama gold field, the promoters of the undertaking have become active, and during the current week official information concerning the project is to be made public. The British expedition which is said to have discovered the reef had the backing of Sir Alfred Mond, Solly Joel, and other big business men.

South African Diamond Production Increases in Value in 1925

Final returns for the diamond production in the Union of South Africa for 1925 show a total production of 2,430,128 metric carats, valued at £8,198,129, compared with 2,440,397.88 metric carats, valued at £8,033,406, in 1924, according to consular advices to the U. S. Department of Commerce.

Production of alluvial stones, from which as a rule come the larger diamonds, fell off materially during the year, amounting to only 239,256 metric carats, against 287,554 metric carats in 1924. The mines, however, increased their production slightly in 1925, amounting to 2,175,326 metric carats against 2,135,262 metric carats in 1924. These figures, however, do not include the production of the important mines in Southwest Africa, for which returns are not yet available.

Lead Mining Developments Undertaken in Bolivia

The rapid rise in the price of lead has caused extensive mining developments to be undertaken recently throughout Bolivia, according to advices to the U. S. Department of Commerce. The total production of lead in Bolivia was 8,986 tons in 1923, 33,625 tons in 1924, and 36,837 tons in 1925. During 1924 and 1925, native miners and operators, whose activities are upon a moderate scale, have been gradually turning their attention to lead, which has been found in many parts of the great area lying between the Western and Eastern Cordilleras from Lake Titicaca to the Argentine border, at an altitude of 12,000 to 16,000 ft. above sea level. The latest deposits discovered are on the Bolivian side of Lake Titicaca and are now being worked upon a fairly large scale.

A London company which is said in Bolivia to be the largest ore buyers in that country was first attracted by what appear to be rich lead deposits on Lake Titicaca. In the summer of 1925 it opened a mine in the Province of Camache, and was soon producing 50 metric tons per month of hand-broken and hand-picked ore which averaged 75 per cent lead and 80 oz. of silver per ton.

Johannesburg Letter

By John Watson

Special Correspondent

Transvaal Native Labor Increases —Onverwacht Platinum Mine Better as Depth Is Gained

Johannesburg, March 16—The output of Transvaal gold for the month of February was declared by the Chamber of Mines on March 10 as 753,924 oz., having a value of £3,202,466. As compared with January, these figures show a decrease of 42,346 oz., equal in value to £179,874. The decrease is explained by the shorter working month. The native labor returns show an increase of 6,326 "boys" at work, on the Rand gold mines, at the end of February, compared with the previous month.

The Crown Mines have recently acquired from the government, at a cost of £200,000, an additional 519 claims on the farm Mooifontein No. 14. There are now sixteen shafts on the Crown Mines property, 850 stamps, and 26 tube mills, with cyanide plant having a capacity of 220,000 tons monthly. In recent years, the revenue from the gold produced has exceeded £3,000,000 annually; and the expenditure on wages and the profits earned represent, each, about £1,000,000 per annum.

William Valentine, a mining engineer of Leydsdorp, has written to the local press, pleading that a fresh trial, under present-day conditions, should be given to the gold and antimony reefs of the Murchison Range, in the Zontpansbey, North Transvaal. A reef occurs there, extending east and west for about 30 miles. As the outcrop showed visible gold and gave rich pannings, the reef was worked by various companies, which sank shafts, erected pumping stations and also batteries. In some cases shafts were sunk to a depth of 200 ft. The ore was said to contain from 6 to 60 per cent antimony sulphide and from 3 dwt. to 1 oz. of gold per ton. The gold could not be freed from the antimony, in those days, and the mines ceased to operate. The value of antimony, then, was only about £12 per ton; whereas, the price in New York is now £80 to £90 per short ton.

The T. C. L. & E. Co. issued a report on March 11, showing that development at the Onverwacht Platinum Mine, at the 250 level, proves that the size of the orebody is more than maintained and the average value of the payable zone at this level is 18 dwt. per ton. The reduction plant milled 654 tons in February. The crude metal produced is estimated to contain 424 oz. of platinoids. Crushing is now proceeding at the rate of about 35 tons per day. Current percentage of extraction is about 75 per cent, and it is expected that this figure will be improved as details of extraction are perfected.

The S.S. "Orca," with 350 tourists, from the United States, sailed from Durban, on March 11. The departing visitors were full of enthusiasm for South African scenery and hospitality, and said their visit had been a revelation to them.

Societies, Addresses, and Reports

Adjustment Committee of American Zinc Institute Unable to Report at St. Louis Meeting on Mine and Smelter Differences

Unexpected Resolution of Tri-State Producers' Association Causes Delay —Leaders in the Industry Contribute Important Technical Papers and Interesting Addresses

By J. H. Wadleigh

(Special Telegraphic Report)

ENTHUSIASM of those who attended the meeting of the American Zinc Institute in St. Louis, Mo., on April 19 and 20 in the hope of seeing some excitement when the report of the committee appointed to adjust the differences between the mine operators and smeltermen was presented, was considerably dampened when it was decided not to place this matter, which is of vital importance to the zinc industry, before the members at this time. This disappointment came about in the following way.

A meeting of the directors of the Tri-State Zinc and Lead Ore Producers' Association was held in St. Louis preceding the scheduled meeting of the Adjustment Committee. Those who attended the meeting were J. F. Robinson, of Miami, Okla., president of the association; F. C. Wallowerk, P. B. Butler, and C. F. Dike, all of Joplin; T. F. Coyne, of Webb City, Mo.; George O. Pearson, H. W. Harrison, and Charles A. Neal, of Miami, Okla., and W. T. Landrum, of Baxter Springs, Kans. A. Scott Thompson, legal adviser for the association, also attended.

Operators Discuss Draft of Findings

At the meeting of the mine operators, the draft of a resolution was discussed, the salient points of which had been previously discussed by the directors before coming to the annual meeting. It was agreed that the resolution contained all of these things which the operators contend they do not know and which they contend are of vital importance in order that the work of the Adjustment Committee might be continued. The resolution of the mine operators was presented to the Adjustment Committee. Its purpose was outlined, and the operator members of the committee then withdrew to allow the smeltermen to discuss the resolutions freely.

Contents of Resolution Not Divulged

Both smeltermen and mine operators refused to divulge the exact contents of the resolution, but among other things it is certain that it asks the smeltermen to present their recoveries from Joplin-Miami ores, to publish smelting costs, to give a more accurate accounting as to sales, and to issue weekly statistics on metal.

The mine operators did not ask for an immediate answer to their resolution. The smeltermen will undoubtedly hold a meeting in the near future, which all of the smeltermen will be asked to attend, and at which time a full discussion will be had. If the members at this meeting agree to the terms of the operators, then the operators say they will instruct their members of the Adjustment Committee to continue negotiations with the smelter members.

Only one reference to the Adjustment Committee was made in the public meetings, that being when President Cobb read the following statement:

"There seems to be some misunderstanding as to the purpose and objects of the formation of an adjustment committee. Reports have been circulated that there has been an attempt to control or fix the price of zinc. I want to say that prices have not been and will not be discussed. We are aiming at better relations between the mine operators and smelters and feel that much has been accomplished by a free discussion of each other's problems."

The issuing of this statement was occasioned by the frequent repetition in the St. Louis papers to the effect that the Institute was trying to come to an understanding on prices, through the effort of the Adjustment Committee. President Cobb's statement was not only considered a reprimand for those who were responsible for conveying such an idea to the press, but was an able and concise statement as to the aim of the committee.

Directors' Report Read

President Cobb called the meeting to order on the first afternoon by requesting the reading of the directors' report. This stated among other things that a direct co-operative arrangement between the President of the Institute and the chairman of the Sheet Steel Extension Committee was entered into last July upon the initiative of the latter. It also stated that a synopsis of the Zinc Workers' Handbook is now being written, which indicates that this book, on which the Institute has been working for years, will soon be issued.

Two things: First, improved milling in the table rooms; and, second, the extraordinary advance made in the knowledge of flotation itself, occasioned the first establishment of flotation as an essential part of Tri-State milling in 1925, C. O. Anderson, of the U. S. Bureau of Mines, stated in a paper that was read at the first session. "A recent estimate shows about ninety Tri-State mills using flotation, and more installations are being made almost daily. About 8 per cent of the total blende production is by the process. This accounts for a production of 1,200 to 1,500 tons of concentrates a week. On the basis of the present district production this figure will probably be doubled in the next two or three years," Anderson stated. The trend of milling practice in the Tri-State district, as viewed by Anderson, is summed up in this sentence: "The gravity plants will more and more assume the rôle of eliminators of tailings, and flotation will actually put an increasingly greater percentage of the total mineral production into the bin."

Smelter Recoveries Discussed

One of the questions that the mine operators have asked smeltermen, namely, "What are the recoveries?" was probably answered by C. E. Siebenthal, of the U. S. Geological Survey, who read a paper on the metallurgical recovery of zinc, which dealt extensively with the question of recoveries.

Galvanizers can probably regain their lost business, maintain their present business, and have an opportunity to increase their business by new usages, C. E. Patterson, secretary of the Sheet Steel Extension Committee, stated.

Two unusually good speeches were heard at the banquet held Monday night. Dr. Edward J. Cattell, of Philadelphia, speaking on brighter days, proved himself to be an optimist, and Earl W. Hodges, director of the Public Relations Bureau of the Henry L. Doherty interests, gave the mining men and smeltermen something to think about along lines of co-operation.

"Simplified practice," a doctrine the preaching of which to industry is one of Secretary Hoover's achievements, was discussed by James A. Stader of the Department of Commerce at the Tuesday morning session, which was presided over by E. H. Wolff, past-president of the Institute.

Recent experiments in the electrothermic metallurgy of zinc were discussed by Dr. Charles H. Fulton, Director of the School of Mines and Metallurgy, Rolla, Mo., and the attitude of the sheet-metal workers towards sheet zinc was discussed by Edwin A. Scott, editor of the *Sheet Metal Worker*.

Depletion Rapid in Tri-State District

Mines of the Tri-State district are being depleted at a tremendous rate, Otto Ruhl, of Joplin, stated, but "There is no likelihood of any shortage of ores being felt during the coming decade," he said.

A round-table discussion of mining and metallurgical improvements, presided over by Dr. Dorsey A. Lyon, Assistant Director of the U. S. Bureau of Mines, closed the convention. The round-table discussions hinged on the several new developments in the treatment of zinc as outlined in the late survey of A. J. M. Sharpe, which was read at the meeting.

President Cobb Re-elected

A. P. Cobb, of New York, vice-president of the New Jersey Zinc. Co., was re-elected president of the American Zinc Institute at the closing session of the organization held at St. Louis, April 19 and 20. A. E. Bendelari, of

Chicago, vice-president and treasurer of the Eagle-Picher Lead Co.; Jesse G. Starr, of Joplin, president of the Quinton Spelter Co., and John A. McCarthy, of New York, Anaconda Copper Mining Co., were elected vice-presidents. Howard I. Young, of Mascot, Tenn., manager in charge of mines for the American Zinc, Lead & Smelting Co., was elected treasurer for the ninth consecutive time. Stephen S. Tuthill was re-elected secretary.

Members of the board of directors to serve three years were elected as follows: E. R. Grasselli, B. N. Zimmer, A. J. McKay, Arthur Thacher, W. N. Smith, John W. Newton, Benjamin Lissberger, and F. C. Wallower. Howard I. Young was elected a director to take the place of Charles W. Baker.

Qualifying Engineers as High Executives

Four Excellent Papers Read at Joint Meeting of Metropolitan Sections of Institutes

By Arthur B. Parsons
Assistant Editor

THE successful executive, be he high or low, is born, not made. The one essential qualification that he cannot do without is his by inheritance. Engineers are as generously endowed in this particular as any others; the problem is to bring them to the front. Boiled down, that seems to be the portent of four very well-written and unusually stimulating addresses by four outstanding engineer-executives, who discussed the subject "The Engineer as an Executive" at a joint meeting of the Metropolitan Sections of the Founder Societies in the auditorium of the Engineering Societies Building on April 14.

Take the comparatively simple case of a shift boss underground, first—and by no means the least important—executive in the structure of any mine organization: To him expertness as a miner undoubtedly is an asset. It is advantageous for him to know in detail how to run an air drill; to load holes and blast; to timber safely, and yet economically; to run electric motors and pumps. Honesty, health, and energy, both mental and physical, are assets. But the able mine superintendent will tell you that the *one* qualification that a good shifter must have is the ability to "handle" his men. The word handle, as he uses it, comprehends a multitude of meanings: the ability to direct, lead, control; to win and hold confidence; to dominate by virtue of stronger yet sympathetic personality; to stimulate and inspire the worker to give his best effort. The subtle power that enables an individual to do these things with unusual success is born in him. It can be developed and supplemented by environment, education, training, and experience, but the real spark must be in the man at the start.

Is the Engineer Backward?

The impression has prevailed generally that the engineer either is backward about seeking or shouldering executive responsibility; or that capitalists are disinclined to select the engineer for such work. One of the speakers raised the novel point that since there are relatively few engineers, compared with the number of doctors and lawyers, bankers and so-called "business men," it might easily be that in spite of a low position numerically, the engineer would rank high if the comparison were made on a percentage basis. Another suggested that when an engineer got to be an executive he shook off the characteristic looks of an engineer (whatever they may be), and accordingly his identity as an engineer was lost. Some reliable statistics as to what the high-powered executives formerly were would be of exceeding interest. The feeling seemed to prevail, however, that whatever may have been the status of the engineer in this respect in the past, he is constantly becoming a more prominent factor in the field of important executive work.

Presiding at the meeting was K. L. Martin, chairman of the Metropolitan Section of the Mechanical Engineers. He justified the presence of three electrical engineers on the program by observing that "the logical place to look for live wires was in the electrical industry."

E. M. Herr, president of the Westinghouse Electric & Manufacturing Co., describing the qualifications of an executive, named first the ability to lead or direct others. He must have initiative; he must shoulder responsibility; he must be able and ready to make decisions for others. He must be ready to work hard and to master the details of his business.

Integrity and high character are, of course, indispensable. These primarily must reside in the individual, but the building of character must continue through life. In the matter of university education, Mr. Herr emphasized, as did one or two of the other speakers, the value of humanistic and cultural studies in conjunction with the fundamentals of science. He mentioned specifically the need for study and practice in the use of English, both talking and writing. The detailed training must, in a large measure, be gained in the particular business in which the individual engages after leaving college. But the man, engineer or other, who succeeds as an administrator, must be a master of the human, the personal, side of the enterprise. He must be a leader of men.

H. A. Guess, vice-president of the American Smelting & Refining Co., the one non-electrical speaker, proved to be quite "live" enough; and at the same time demonstrated that one mining engineer, at least, in addition to thinking golden thoughts, can prepare an address that really stands high from the standpoint of literary merit. A tradition to the contrary, with respect to this final item, frequently is accepted by mining engineers in a most spiritless way.

It was Mr. Guess who advanced the theory that the proportion of mining-engineer executives to mining engineers is not so low as many think. He regarded it as a miracle, in view of the complexity of modern legal procedure, that any high executive position is *not* filled by a lawyer—or at least he said he did. Bankers, naturally, fill the rôle of executives, because they have the cash; they operate bonanza mines and of course are more or less exalted!

No Standard Formula

There is no standard formula for making an executive, says Mr. Guess. Much of the joy of living would be gone if there were. He offered suggestions for improving the curricula at mining schools with diffidence; he thought they were functioning pretty well. Detailed technical training should be subordinated and stress should be laid on (1) accounting and methods of cost analysis; (2) subjects tending to give the student a better understanding of human nature and give him a more sympathetic attitude toward his fellow-men; (3) writing and speaking—with clarity and ease as the objects; (4) broad fundamental subjects in science and engineering; (5) enough of technical details to qualify the graduate to hold a job as sampler, assayer, or surveyor.

Qualities that help the young engineer to advance to positions of authority are integrity, sustained energy, skilled knowledge, tact, common sense, and personality; this last being a rather broad term that implies the ability to direct men. Training and experience can stimulate and foster these qualities, but in a large measure they are part of the character that the individual has inherited. Mr. Guess proposed a revision in punctuation of the well-known lines of Shakespeare, to read as follows:

"There is a divinity that shapes our
ends rough,
Hew them how we will."

F. B. Jewett, another electrical engineer, and one of the vice-presidents of the American Telephone & Telegraph Co., declared that he approached the subject with some trepidation. No simple set of qualifications can be laid down; nor can essential rules be prescribed to the young engineer for reaching the goal of high executive position. Character, generally inborn, but modified by training and environment; personality — that intangible something that wins respect and leadership; imagination, initiative, judgment, decision, self-reliance, these are some of the qualities required.

Growing Dependence of World on Engineering

Mr. Jewett stressed the fact that normal human existence is to an ever-increasing degree dependent directly upon the products of engineering and applied science. As a consequence of this tendency the wise administration of business today involves decision based on engineering knowledge. The executive may, of course, rely on the advice of a technical staff, but if he has the special qualifications of an executive, the engineer himself, ought to do more effective work than the non-technical executive.

Basing his remarks presumably on his own experience, Mr. Jewett told of the systematic selection of men with the end in view of perpetuating an organization of engineer-executives. Men whose record in college suggests qualities of leadership are put through a course of training designed to avoid progress along narrow technical lines. They are given opportunity to develop, to familiarize themselves with human and commercial phases of the business. Mistakes in selection are made, but nevertheless an excellent body of potential executives is built up.

Brooklyn Edison Co. Engineer-Managed Corporation

The Brooklyn Edison Co. apparently is pretty much an engineer-managed corporation. Shareholders agree that it is also exceptionally well managed, and the balance sheet shows this to be the case. John C. Parker, vice-president and chief engineer for this company, was the last of the electrical trio of speakers. In these days of keen business competition, capitalists and boards of directors usually make merit the basis of selection of corporate executives. It must therefore be the fault of engineers if they have not their share of the important, and consequently well paid, positions. Mr. Parker thinks that accurate statistics would make a better showing for engineers than they are accorded by generally accepted impression.

The engineer who aspires to high executive position should, first, be a *good* engineer. He should have "a speaking acquaintance with engineering processes" and "an intuitively scientific habit of mind." But he must be more, much more, than a technician. He should be able to analyze, to put his mental finger on guiding principles. He should deal in generalizations, but not in generalities. Above all, he should be a human being with a desire to render service to society. Democracy, kindliness, understanding, sympathy, "social mindedness." Right relations with other human beings—employees, associates, the public—Mr. Parker holds to be the pre-eminent requirement of a good engineer and of a good executive.

Custom of Railroads Regarding Engineers Varies

Though he had no prepared speech, George J. Ray, chief engineer for the D. L. & W. railway, contributed an account of some of his experiences. Certain railroads, it seems, are inclined to advance engineers to executive positions in many departments; others rarely do. He has found a strong preference on the part of some young engineers to stick to one particular sphere of work, rather than to switch around and vary their experience. In the railroads, "operating" men usually progress to executive positions, partly because of their varied contact with men in many localities and in many departments of the railroad organization. They may have no greater capacity for leadership, but they have the opportunity and the desire to show their abilities to their superiors.

Mr. Martin told of one large corporation in which engineering graduates whose extra-curriculum activities have suggested executive ability have been placed in succession in the technical, accounting, publicity, selling, statistical, clerical, shop, and employment departments. This helped to equip them to hold executive positions; but primarily the process afforded the opportunity to see whether they had the first essential qualification—the ability to direct the efforts of others.

H. A. Guess

Apparently the problem is not so much to train engineers to be executives, as it is to select from a group having unusually high native intelligence and excellent education those who have the rare, inherited genius for leadership that makes them effective in executive positions.

State and Federal Geologists to Co-operate

Representatives of the Colorado Metal Mining Fund, of which M. B. Tomblin, of Denver, is secretary, met with representatives of the U. S. Geological Survey recently, and it was agreed that the state will co-operate with federal authorities for three years in the making of a geological survey of Colorado. This work will bring geological data and information up to date and should prove an incentive for renewed activities. The state mining fund will pay $10,000 a year for the work, the cost of which will be about $50,000.

Tri-State Branch American Zinc Institute Elects Officers

Stephen S. Tuthill, secretary of the American Zinc Institute, aroused considerable interest in the Joplin-Miami district in an address made before the Tri-State branch of the American Zinc Institute at Picher, Okla., when he declared if the ore producers and smeltermen in the industry do not get together the government will be asked to do what it can to bring them together.

Ore producers are frankly curious as to how and why government interference is to be brought about. They feel they have been doing their best to get along with the smelters, and that if there is a condition that needs correcting it is not their fault.

W. L. Landrum, manager of the Cortez-King Brand Mines Corporation, was elected president of the Tri-State branch of the American Zinc Institute at a meeting of directors held at Picher, Okla., on April 14. Fred N. Bendelari, of Joplin, Mo., president of the Consolidated Lead & Zinc Co., was elected first vice-president, and H. H. Landreth, of the Landreth Machinery Co., also of Joplin, second vice-president. Richard Jenkins, of Baxter Springs, Kan., was re-elected secretary and treasurer.

Stage Set for Hammond Dinner

Every important world capital will be the scene on the night of May 3 of a foregathering of friends of John Hays Hammond, eminent engineer, diplomat, and former chairman of the United States Coal Commission. The gatherings, which will center around a great dinner to be held at the Waldorf-Astoria Hotel in New York on the same date, will celebrate Mr. Hammond's seventy-first birthday, which occurred March 31. He was in Paris at the time, so the company of friends promoting the world tribute decided to await his return from overseas.

Arrangements for the New York dinner and for many smaller functions to be held everywhere are in the hands of Herbert Wall, whose headquarters are at No. 42 Broadway, New York.

New Maps of Western Quebec

Two geological maps of interest to mining men and prospectors have recently been published by the Canadian Geological Survey. They show on a scale of one mile to one inch an area of eight hundred square miles, including a large part of Rouyn, Bellecombe, Dufresnoy, Destor, Aiguebelle and Manneville townships and the townships of Clericy, Lapause, Joanne, Bousquet, Vaudray and Montanier. These maps exemplify a commendable departure in mapping that will be greatly appreciated by prospectors. Various rock formations are represented, as usual, by different colours, but in the matter of representation of the actual outcroppings of rock some new methods have been adopted. Copies of these maps may be had on application to the Director of the Geological Survey, Ottawa, Canada.

U. S. Chamber of Commerce Meets

Representatives of more than 1,400 business organizations located in every state in the Union have been invited to attend the three-days' annual meeting to be held in Washington May 11 to 13 by the direction of the Chamber of Commerce of the United States. The preliminary program shows that the questions to be considered are of importance to all branches of industry, finance, and commerce. The major subject, around which all the discussions of the meeting will center, will be "Self-Regulation in Business." Prominently featured on the program are two additional subjects—namely, "Local and State Taxation and Budgeting," and "Relations of the States to the Federal Government."

Men You Should Know About

C. M. Loeb, president of the American Metal Co., recently returned from Honolulu.

Robert D. Ferron has opened an office as consulting engineer in La Paz, Bolivia.

Courtenay De Kalb has just been at Ducktown, Tenn., and will shortly be in New York City.

C. F. Kelley, president of the Anaconda Copper Mining Co., sailed for Europe on April 14.

Albert Burch, mining engineer of San Francisco, is in Butte as consultant on litigation work.

M. I. Goldman, of the Geologic Branch of the U. S. Geological Survey, left for Spain, April 15.

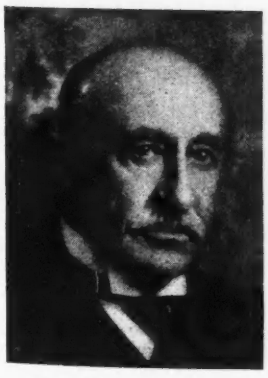
E. J. Schrader, mining engineer, with headquarters at Reno, Nev., is in St. Paul, Minn., on an extended trip.

Charles E. Rogers, of London, who had been in Johannesburg for over a year, recently arrived in New York.

L. E. McDonnell has been appointed superintendent of the milling plant of the California Zinc Co. at Winthrop, Calif.

T. B. Nolan, of the Geologic Branch of the U. S. Geological Survey, left Washington on April 15 to continue field work in the Gold Hill district, Utah.

John Hays Hammond, who returned last week from Europe on the "Olympic," accompanied by his daughter, Miss Natalie Hays Hammond, was met down the bay by a delegation of friends, who extended to him an invitation to be their guest of honor at a banquet to be held on May 3, Mr. Hammond's seventy-first birthday. Mr. Hammond, thus reminded of his hardy maturity, is said to have told his friends and the representatives of the press, "I eat what I want. Sleep when I want. Drink what I want. In fact, I do everything I want. I also worry." The last statement affords occasion for analytic speculation and introspection on the part of mining engineers and professional men in general.



John Hays Hammond

H. Kingsmill, general manager of Cerro de Pasco Copper Corporation, and **P. A. Robbins**, former manager of Hollinger Gold Mines, Ltd., recently sailed for South America.

J. E. Warren, of the Casper office of the Conservation Branch of the U. S. Geological Survey, resigned on April 5. **G. G. Law** was transferred from the Denver office to the Casper office on April 1.

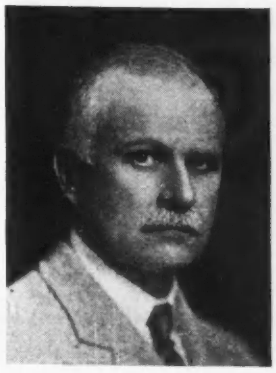
Franklin W. M. Cutcheon, of New York City, has been elected a member of the board of directors of New Cornelia Copper Co. to fill the vacancy caused by the death of the late General John C. Greenway.

Guy C. Riddell has left New York for Santa Maria, Calif. He will be on the West Coast for several months, and will visit mines and oil fields in which he is interested in Idaho, Utah, Wyoming, and Colorado.

G. C. Bateman, of Toronto, Secretary of the Ontario Mining Association, delivered an address on April 13 before the Mining Bureau of the Winnipeg Board of Trade, dealing with mining development in Ontario. On his return to Toronto he stated that he was much impressed with the activity of the mining industry in Manitoba and the prospect of its rapid expansion in view of projected railroad construction.

Stanly A. Easton, of Kellogg, Idaho, general manager of the Bunker Hill & Sullivan Mining & Concentrating Co., whose term as a member of the State Board of Education expired April 5, has been reappointed by Governor Moore for five years. The State Board of Education under the Idaho system has supervision over all educational institutions, which include the state university, two normal schools, a technical institute, a school for the blind and deaf, and the industrial training school. These are all growing institutions and their management requires much time and business capacity of a high order. In giving this service to the state without compensation, Mr. Easton presents a fine example of state loyalty which is alike creditable to himself and to the mining industry.

Daniel C. Jackling, of San Francisco, has been awarded a gold medal by the Mining and Metallurgical Society of America for his achievements in developing low-grade mines. Presentation of the medal will be made in October next at a dinner of the society, to be held in New York. Mr. Jackling is a director of the Ray Consolidated Copper Co., in Arizona, the Chino Copper Co., in New Mexico, and the Nevada Consolidated Copper Co., and is also interested in the production of low-grade porphyry coppers. When he undertook the development of a mountain of copper ore in Bingham Canyon, Utah, which had previously been considered too low grade for commercial use, he for the first time employed steam-shovel methods, after the practice in the iron mines on the Mesabi range. This brought the Utah Copper Co. up to the production of 28,000 tons a day.



Dr. Ernest Howe

Dr. Ernest Howe, Yale '98, of New Haven and Litchfield, Conn., has been appointed Editor of the *American Journal of Science* by Yale University, and after he has had an opportunity to become acquainted with the editorial details will assume the active editorship. **Professor Dana** will continue his previous connection with the *Journal* and **Professor Bateman** will act as advisory editor. Dr. Howe is a consulting mining geologist who has been actively engaged in mining work in California for a number of years. At the request of the Mexican Government in 1920 he helped to reorganize the Mexican Geological Survey. He is a director of the North Star Mines Co. and has contributed papers on mining and geological subjects to various technical journals. In 1924 Dr. Howe was elected a member of the Connecticut State Senate, previously having served as a member of the Connecticut General Assembly, as clerk of the Committee on the Civil Administration Code, and in 1922 as a delegate to the State Republican Convention. *The American Journal of Science* was established in New Haven by Benjamin Silliman in 1818, and for more than a century has been edited in New Haven by Benjamin Silliman the elder, Benjamin Silliman the younger, James Dwight Dana, and Edward Salisbury Dana, all geologists.

Obituary

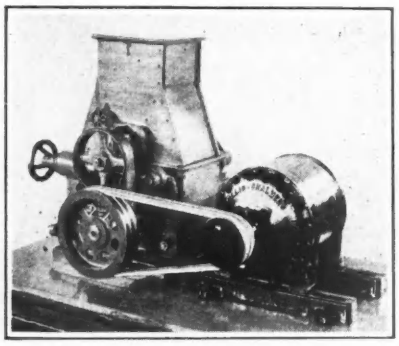
John W. Shay, president of the Shay-McMullen Oil Co., and vice-president of the Greensboro Gas Co., prominent in the oil fields of western Pennsylvania, Ohio and West Virginia, died on April 7, in Pittsburgh, aged seventy-one.

Bertrand Chase Hinman, a retired mining man, of New Rochelle, died on April 16 in his fifty-eighth year, Mr. Hinman was born in Mannsville, N. Y., was graduated from the School of Mines, Columbia University, in 1890, and received the degree of Master of Arts from Columbia in 1891. For many years Mr. Hinman made his home in London, where he was director of several gold and copper mining companies. In 1917 he retired from active business and returned to the United States. He was a member of the Institution of Mining and Metallurgy of England and the A.I.M.E.

New Machinery and Inventions

Small Rolls Designed for Test Work

A machine for experimental purposes, primarily in the paint, vegetable oil and chemical industries but also in certain other fields, is the set of "experimental rolls," shown in the accompanying cut and made by Allis-Chalmers Manufacturing Co., Milwaukee, Wis. This small set of crushing rolls, housed in wood and provided with a Texrope and motor drive, is used for crushing and grinding samples of various materials, either for routine specification tests or in experimental work.



This small set of crushing rolls is intended for testing or experimental work

An Air Filter for Compressors and Gas Engines

Trouble in the operation and maintenance of air compressors and internal-combustion engines can be avoided to a considerable extent by filtering out the dirt, dust, and abrasive materials from the air before it is drawn into the cylinder. An air filter designed for this purpose is manufactured by the Spray Engineering Co., 60 High St., Boston, Mass.

The basic principle of air filters of this make is the removal of the dust particles by causing them to impinge against an adhesive surface by rapidly and repeatedly changing the direction of the air flow. The filter media is arranged from coarse to fine in the direction of air flow, so that where the largest percentage of dust is retained, ample space is provided for the accumulation of it without materially obstructing the flow of the air. By dipping or charging the cell with a special solution called "Dustix," the surface of the filter media is made adhesive. When the filters become dirty they may be cleaned by washing them in a hot solution of water and washing soda.

These filters are built entirely of heavy-gage metal to withstand hard usage. They are made in two types—namely, type "C" and the box type. Type "C" filters are intended for small capacities, and the box type has been designed for larger capacities. The former are small and light and can be bolted to a standard pipe flange, which, in turn, is screwed directly onto the air intake pipe.

Synchronous Motors with High Starting Torque

Heretofore, synchronous motors have had a low starting torque. The General Electric Co. of Schenectady, N. Y., has, however, designed and is now marketing a line of these machines for general-purpose application. These motors are recommended to drive loads, the torque requirements of which have been heretofore met by standard squirrel-cage induction motors. The new ma-machines, known as types TS and QS of the 7,500 series, range from 20 to 150 hp. at speeds of 1,200, 900, 720, and 600 r.p.m. at 60 cycles.

These motors meet all the Electric Power Club requirements for general-purpose machines and give satisfactory starting characteristics. They are of strong construction and with minor changes will operate at either unity, 90-per cent or 80-per cent power factor. They are rated at 40 deg. continuous load at unity power factor, and at 90- and 80-per cent power factor the temperature of the stator will not exceed 40 deg., with 50 deg. on the rotor.

Adequate starting torque is the most important factor in the design of the new motors, each machine being guaranteed to deliver the same starting torque with the same inrush current as will a standard squirrel-cage induction motor of similar rating. At full-line voltage the motor will accelerate and synchronize a load whose torque is 100 per cent of the rated full-load torque of the machine.

Revolving fields are employed on these motors. These are of the salient-pole type and are separately excited, ordinarily by means of direct-connected exciters. One of the principal advantages inherent in these machines lies in the fact that the amortisseur windings are not limiting factors upon the temperature rating. These starting windings will not become dangerously hot before the primary motor coils are overheated. Thus adequate overload protection in the alternating current lines will also protect the amortisseur windings from overheating whether as a result of failure to start or because of operation without excitation.

Semi-automatic control is recommended for these motors. In this control field excitation is automatically applied. The motor is started by means of a manually operated, self-contained compensator. The manipulation necessary to start one of these machines is, therefore, identical with that entailed in starting a squirrel-cage induction motor.

Special-Sheathed Electric Wire Approved for Use

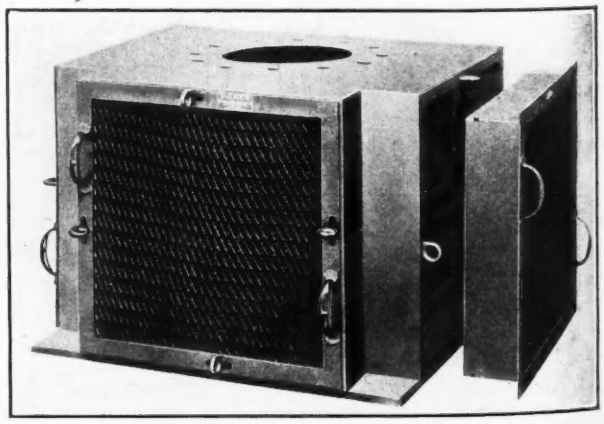
The non-metallic sheathed cable, known as RomeX and manufactured by the Rome Wire Co., of Rome, N. Y., which has been a subject of much debate in the electrical industry during the last four years, has finally been approved by the National Fire Protective Association. This action will permit the Rome Wire Co., to begin production of this product and place it on the market in competition with other insulated wiring now used on all types of circuits under 300-volt potential. The accompanying sketch shows the construction of this wiring. The core or beginning of RomeX cable is a standard rubber covered code wire, marked *A* in the sketch. *B* is a close wrap of fibrous tape formed from six thicknesses of long fiber kraft paper. The cotton braid *C* is then applied and carefully saturated with fire resistant compound. Another wrap *D* of the long fiber kraft tape is next applied and two or more of the conductors are thus sheathed together with filler cords *E* under a very heavy braided outer jacket *F* The materials marked *D*, *E* and *F* are all treated to make them fireproof and moisture-proof.

Sketch showing construction of new non-metallic sheathed cable

A New Pipe Machine

The Borden Co., Warren, Ohio, has put out a machine for threading and cutting pipe called the "No. 44 Beaver power drive." This is a portable machine in which the pipe revolves and the tool remains still. Cutters can be bought for it or it can be used with hand tools. It holds pipe from ¼ to 2-in. diameter. By means of a universal-jointed shaft, it will cut 2½ to 6-in. diameter pipe by driving a No. 106 Beaver cutter.

This box type air filter is made of heavy-gage metal and designed to have large capacity



The Market Report

Metal Prices Taper Off Further

Declines in London, Owing to Fear of Coal Strike, Affect Entire List

New York, April 21, 1926 — Copper, lead, zinc, silver, and tin have all been at new low levels for the present movement in the last day or two. Lead is the only one of the lot in which the volume of sales during the week has been well maintained, though the low prices asked for tin yesterday attracted a good day's business and zinc sales have been spasmodically good. The weakness seems to have had its origin in London, the lower cables scaring off purchasers in the United States. The threatened coal strike in England is held to be chiefly responsible.

Copper Below 14c., Delivered

On Thursday, Friday and Saturday copper was sold in fair volume at 14c. delivered in the East and at 14⅛c. in what is known as the Middle West. On Monday, however, with lower prices reported from London, no consumers could be interested at those levels, and even an offer at 13.95c. met no response. Yesterday a limited number of sellers quoted 13⅞c., at which small sales were made, and today business has been booked, in a small way, at 13.85c. delivered in the East. Most sellers have not met these lower prices, but there seems to be plenty available to take care of the very limited demand. Most of the inquiries have been for May and June, and the week's business, which was considerably less than that of last week, has been made up principally of small orders rather than a few large ones. Much of the copper sold has been for the manufacture of brass. The brass mills continue operating at or near capacity, but advance orders are not quite so large.

Copper producers and sellers are in general holding firm and do not expect any important decline in prices, even though the general tendency of raw material prices seems to be distinctly downward. Their confidence is founded on the excellent statistical position of the metal; on the organization of the new Copper Export Association, which will be launched within a few weeks according to present indications, and which is expected to stabilize prices; and to the slightly improved conditions in Germany, the principal foreign consumer. German buying has been better this week than for some time, principally at 14.15c., c.i.f., the orders being for prompt delivery and well distributed. The Orient has recently showed more interest also.

Lead Decline Continues

With the London market off to such an extent that Mexican bullion lead netted as much in New York as abroad, the American Smelting & Refining Co. on Monday, April 19, reduced its official contract price for New York lead from 8c. to 7.85c. Yesterday and today large sales for late May and early June delivery were made at 7.75c. New York. The St. Louis market kept in close step with New York, the prevailing quotation there being 7.60c. today, with rumors that 7.55c. might be done on small lots. The volume of business, particularly in New York but also in St. Louis and Chicago, has been good, this being true before the Smelting company reduced its price, as well as in the last three days. Without exception the larger producers are well sold for April, and one or two of them at least have only small quotas of June lead on their hands. Buyers are covering only early requirements, and producers therefore look for continued good demand in the domestic market. Large sales of antimonial lead at a good premium were made by one seller.

Daily Prices of Metals

April	Copper N. Y. net refinery*	Tin		Lead		Zinc
	Electrolytic	99 Per Cent	Straits	N. Y.	St. L.	St. L.
15	13.775	63.00	64.25	8.00	7.775@7.80	7.00@7.05
16	13.75	62.75	64.00	7.975	7.75@7.80	7.00
17	13.75	62.75	64.00	7.95	7.75@7.80	7.00
19	13.70	62.25	63.375@63.50	7.85	7.65@7.70	7.00
20	13.625	61.25	62.50@62.625	7.75@7.85	7.60	6.95
21	13.60	61.625	62.875	7.75@7.85	7.60	6.90@6.95
Av.	13.700	62.271	63.521	7.896	7.702	6.983

The prices correspond to the following quotations for copper delivered: April 15th, 14.025c.; 16th and 17th, 14.00c.; 19th, 13.95c.; 20th, 13.875c.; 21st, 13.85c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

London

April	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
15	57¾	58⅛	64¾	286¾	273¾	29⅛	29 9/16	32¾	33⅛
16	57½	58⅜	65	285¼	273¼	28 15/16	29⅜	32⅝	33 1/16
19	57¼	58⅛	64¾	284¼	271¾	28 5/16	28 13/16	32⅜	32¾
20	56⅞	57¾	64¼	279	267¼	27 15/16	28 7/16	31⅞	32¼
21	56¾	57⅝	64½	281	269¾	27⅞	28 7/16	31 15/16	32¼

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

April	Sterling Exchange "Checks"	Silver		Gold London	April	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
15	4 85⅜	64⅜	29¾	84s 11½d	19	4.85⅜	63⅜	29 5/16	84s 11½d
16	4 85⅝	63⅞	29½	84s 11½d	20	4.85 11/16	63½	29 7/16	84s 11⅝d
17	4 85⅝	63⅜	29 5/16	.....	21	4.85 11/16	63¼	29¼	84s 11½d

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London silver quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command three-eighths cent premium.

The rate of mine production of lead in the United States and Mexico increased in March, but the rate of world output declined slightly. The total for March was 111,365 tons; February, 103,441.

Zinc Drops Under 7c.

Most of the zinc has been sold rather than bought during the last week, producers finding that tempting bait was necessary to find a market for their product. The principal cut in prices came last Thursday, when several hundred tons were finally sold at 7c., though nominal prices had been 7.10c. On Monday and Tuesday further good sales were made, though in small lots only, as the galvanizers were in no mood to speculate on the future by laying in an excess supply of the metal. The 6.95c. level at which business was done yesterday was no longer attractive today, and there was considerable doubt as to whether even quotations of 6.90c. would be favorably received. Resale lots are rumored to have been offered at this lower level. High-grade is quoted at 8¼@8⅝c.

Consumers Buy Tin

After easing gradually since last Wednesday, spot Straits tin reached 62.5c. per lb. yesterday, Tuesday. On the break, consumers entered the market and in the afternoon good sales were made at 62.625c. Forward tin is easier with concessions for those positions ranging up to 4c. per lb. for three months ahead.

Silver Down to 63¼c.

New low prices for silver were established both in London and New York on April 21st, continued selling for China account being responsible for the decline to 63¼c. The Indian bazaars are moderate buyers, but only at low rates, and show no desire to force prices upwards.

Mexican Dollars: April 15th, 49⅜c.; 16th, 49c.; 17th and 19th, 48⅝c.; 20th, 48⅜c.; 21st, 48¼c.

Francs Still Dropping

Francs have registered a new low every day recently. The premium on Canadian funds has resulted in the shipment of gold from New York to Montreal. Closing cable quotations on Tuesday, April 20, were: francs, 3.32c.; lire, 4.025c.; and marks, 23.81c. Canadian dollars, ½ per cent premium.

Other Metals

Quotations cover large wholesale lots unless otherwise specified

Aluminum—99 per cent grade, 28c. per lb.; 98 per cent, 27c. London, 98 per cent, £118 per long ton.

Antimony—Per pound, duty paid, New York: Chinese brands, spot, 17.50c. May arrival, 16.50c. Cookson's "C" grade, spot, 22c. Market very quiet and spot prices mostly nominal.

Bismuth—$2.70@$2.75 per lb., in ton lots. London, 10s.

Cadmium—60c. per lb. Market better. **London, 1s. 9d. for Australian metal.**

Iridium—$225 per oz. for 98@99 per cent. Nominal. London, £70@£75 for 99.5 per cent.

Nickel—Ingot, 35c.; shot, 36c.; electrolytic, 39c. (99.75 per cent); London, £170@£175 per long ton.

Osmium—$85@$90 per ounce; London, £19@£22.

Platinum — $112 per ounce refined officially quoted. Sales also at $105@$107. Crude, $103. London, £22½@£23½ for refined; crude, £21@£22.

Quicksilver—Per 75-lb. flask: market firmer at $90. San Francisco, $89.33. London, £14⅝.

Ruthenium — $75@$85 per ounce; London, £13@£16.

The prices of Cobalt, Germanium Oxide, Lithium, Magnesium, Molybdenum, Monel Metal, Palladium, Radium, Rhodium, Selenium, Tellurium, Thallium, Tungsten, and Zirconium are unchanged from the issue of April 3.

Metallic Ores

Tungsten Ore—Per unit of WO_3, N.Y.: Wolframite, $11@$11.50; Western scheelite, $12@$13. Domestic demand very light, and prices largely nominal.

Vanadium Ore—Containing 4 to 8 per cent V_2O_5, 30@35c. per pound of V_2O_5 f.o.b. Montrose, Colo.

Foreign concentrate (lead vanadate) 12 to 18 per cent V_2O_5, 60@65c. per pound V_2O_5, duty paid, seaboard.

Chrome Ore, Manganese Ore, Molybdenum, Tantalum, and Iron Ores are unchanged from quotations in the April 3 issue.

Zinc Blende and Lead Ore Prices Unchanged

Joplin, Mo., April 17, 1926

Zinc Blende		Per Ton
High		$52.90
Premium blende, basis 60 per cent zinc	$48.00	49.00
Prime Western, basis 60 per cent zinc		47.00
Fines and slimes, 60 per cent zinc	46.00	43.00
Average settling price, all zinc ores		46.56

Galena	
High	$103.30
Basis 80 per cent lead	95.00
Average settling price, all lead ores	100.16

Shipments for the week: Blende, 18,790; lead, 1,784 tons. Value, all ores for the week, $1,053,570.

Purchases reported to 6 o'clock totaled only 15,000 tons, 5,000 tons less than last week. The shipment was 1,600 tons more than the production, but the slow sales today indicate a reversal next week, with production more than the shipment. Though buyers have 15,000 tons contracted for, it is reported that nearly half of this tonnage is not yet mined, leaving an approximate net reserve stock of 22,000 tons.

Platteville, Wis., April 17, 1926

Zinc Blende	Per Ton
Blende, basis 60 per cent zinc	$ 49.50

Lead Ore	
Lead, basis 80 per cent lead	100.00

Shipments for the week: Blende, 1,137 tons; lead, 40 tons. Shipments for the year: Blende, 15,203; lead, 402 tons. Shipments for the week to separating plants, 1,475 tons blende.

Non-Metallic Minerals

Amblygonite, Andalusite, Asbestos, Barytes, Bauxite, Borax, Celestite, Chalk, China Clay, Diatomite, Emery, Feldspar, Fluorspar, Fuller's Earth, Garnet, Gilsonite, Graphite, Greensand, Gypsum, Ilmenite, Iron Oxide, Lepidolite, Limestone, Magnesite, Manjak, Mica, Monazite, Ocher, Phosphate, Potash, Pumice, Pyrites, Quartz Rock Crystal, Rutile, Silica, Spodumene, Sulphur, Talc, Tripoli, and Zircon are unchanged from prices in the April 3 issue.

Mineral Products

Arsenious Oxide (White arsenic)—3¼@3½c. per lb. Inquiries improving. London, £14@£15 per long ton.

Copper Sulphate, Sodium Nitrate, Sodium Sulphate, and Zinc Oxide are unchanged from prices in the April 3 issue.

Ferro-Alloys

Ferromanganese — Domestic, 78@82 per cent, $88@$90 per gross ton furnace; prompt and future.

Several hundred tons of spiegeleisen was sold at $34, furnace, for the 20 per cent grade, in carloads, with $33 on lots of 200 tons or more. It is understood $32 is the lowest price on producers' books. This price applied only to large tonnages.

Ferrocerium, Ferrochrome, Ferrophosphorus, Ferrosilicon, Ferrotitanium, Ferrotungsten, Ferro-uranium and Ferrovanadium are unchanged from prices in the April 3 issue.

Metal Products

Rolled Copper — Sheets, 22½c.; wire, base price, 16c. per lb.

Zinc Sheets — 11.75c. per lb., f.o.b. works.

Lead Sheets, Nickel Silver, and Yellow Metal are unchanged from prices in the April 3 issue.

Refractories

Chrome Brick, Firebrick, Magnesite Brick, Silica Brick, and Zirkite are unchanged from prices in the April 3 issue.

Steel Steady—Pig Iron and Coke Dull

Pittsburgh, April 20, 1926

The turn in the volume of steel buying, as a whole, has plainly been rounded recently in definite fashion, but there is no slump in demand—merely a gradual tapering off. The condition differs from experience in each of the last three years, at approximately this time of year, in that buyers have not accumulated stocks, and thus liquidation does not add to the decrease in buying, which merely follows a slow decrease in consumption in various lines, while in a few lines consumption is increasing seasonally.

Pig Iron. — Bessemer quiet at $19.50@$20; basic, $18.50@$19; foundry, $19, f.o.b. Valley furnaces.

Connellsville Coke. — Spot furnace remains at $3@$3.15 while spot foundry is off 25c. at $4@$4.50.

Company Reports

Utah Copper Earned $6.83 per Share in 1925

The Utah Copper Co., during the year ended Dec. 31, 1925, earned a net income of $11,103,504 after expenses, depreciation, federal taxes, and other charges, but before depletion, equivalent to $6.83 per share. This compares with $8,185,319, or $5.03 a share, in 1924. After the payment of $6,904,082 in dividends, surplus was $4,199,422, against $1,687,359 in the previous year.

Current assets as of Dec. 31, 1925, totaled $27,690,281, against liabilities of $7,006,005, making a net gain in surplus quick assets of $3,600,923.

The tonnage of ore treated at the Magna and Arthur plants was 6,662,100 and 5,876,200 tons, respectively, or a total of 12,538,300 tons, equivalent to a daily average of 34,351 tons. The average copper content of the ore was 1.02 per cent, or 20.4 lb. per ton, compared with 1.07 per cent and 21.4 lb. for the year 1924. The average recovery was 86.96 per cent, corresponding to 17.78 lb. of copper per ton, compared with 85.94 per cent and 18.43 lb. for the year 1924. The average milling cost per ton of ore was 54c., a decrease of 6c. compared with 1924.

The production from all sources, as compared with the year 1924, was as follows:

	Year 1925	Year 1924
Gross pounds in concentrates	222,978,209	223,524,127
Gross pounds in precipitates	737,644	300,460
Gross pounds in scrap copper	8,789	165,589
Totals	223,724,642	223,990,176

After necessary allowances for losses in smelting and refining, the net production of refined copper for 1925 was 214,162,139 lb.

The average cost per net pound of copper, including depreciation of plant and equipment and all fixed and general expenses and after crediting gold, silver, and miscellaneous earnings, was 8.43c., as compared with 8.89c. for the preceding year, computed on the same basis. The value of the gold and silver recovered and the miscellaneous earnings amounted to 1.36c. per pound of copper, as compared with 1.206c. for the previous year.

Statement of Operations for the Year Ended Dec. 31, 1925

Operating Revenue		
Copper produced—214,162,139 lb. @ 14.069c.		$30,130,561.89
Gold produced—78,158.432 oz. @ $20		1,563,168.64
Silver produced—692,782.49 oz. @ 69.02c.		478,152.46
		$32,171,882.99
Operating expenses		
Mining, including stripping expense	$4,282,333.30	
Ore delivery—mine to mill	1,443,082.73	
Milling	6,748,331.44	
Treatment, freight and refining	7,010,871.55	
Selling expense	267,702.71	19,752,321.73
Profit from operations		$12,419,561.26
Miscellaneous income—net		1,118,541.67
Total income		$13,538,102.93
Charges against income:		
Depreciation	$1,207,270.38	
Federal income tax and other charges	1,020,894.12	
Loss on plant and equipment retired	206,433.63	2,434,598.13
Net income to surplus account		$11,103,504.80

McIntyre Porcupine Earnings Increase

Quarterly earnings of the McIntyre Porcupine Mines, Ltd., operating in the Timmins district in Ontario, for the fiscal year to date, are shown in the following table:

	First Quarter Sept. 30, 1925	Second Quarter Dec. 31, 1925	Third Quarter March 31, 1926	Total Fiscal Year to Date
Gross recovery	$886,117	$946,688	$972,399	$2,805,206
Costs, including development	518,793	539,178	537,812	1,595,784
Operating earnings	$367,324	$407,510	$434,587	$1,209,422
Non-operating revenue	24,040	24,972	27,853	76,867
	$391,364	$432,482	$462,441	$1,286,289
eLess provision for taxes for period	18,754	14,887	18,604	52,246
Net earnings before plant depreciation	$372,610	$417,595	$443,836	$1,234,042

Magma Copper Cost 7.51c. per Pound

The Magma Copper Co., operating in the Superior district, in Arizona, produced 27,020,516 lb. of refined copper during 1925 at a cost of 7.51c. per pound, exclusive of depreciation and interest. The company realized 14.007c. per pound.

During the year a total of 229,377 tons of all classes of ore was produced from the Magma mine. This ore averaged 6.50 per cent copper, 3.43 oz. of silver, and 0,031 oz. of gold. The net metal production for the year including some lease and customs ore, after deducting all losses including refining, was 27,020,516 lb. of copper, 719,881.22 oz. silver, and 9,085,653 oz. gold.

Current assets as of Dec. 31 totaled $3,137,358, against current liabilities of $595,689.

Consolidated Income and Expense Statement for the Year Ended Dec. 31, 1925

Sales of copper			$4,005,719.33
Cost of sales:			
Inventory of metals, ores and concentrates, Jan. 1, 1925		$1,408,249.27	
Operating expenses	$2,594,034.89		
Depreciation	348,487.10		
Reserve for liability insurance	55,122.33		
	$2,997,644.32		
Less gold and silver sales	670,779.62		
		2,326,864.70	
		$3,735,113.97	
Inventory of metals, ores and concentrates, Dec. 31, 1925		1,214,422.52	
			2,520,691.45
			$1,485,027.88
General, administrative and engineering expenses			111,056.04
			$1,373,971.84
Interest and other income			40,098.10
			$1,414,069.94
Railroad net income			37,998.55
			$1,376,071.39
Other deductions			
Interest on bonds, etc.			419,422.41
Net gain for the year			$956,648.98

Inspiration Produced 81,944,321 Lb. of Copper in 1925

Operations of the Inspiration Consolidated Copper Co., in the Miami district, in Arizona, during 1925 resulted in the production of 81,944,321 lb. of fine copper, at a cost, including depreciation, but not depletion, of 12.2858c. per pound. The grade of the ore mined was 1.038 per cent copper. This was lower than anticipated.

It was found that mining conditions were very different from what could be reasonably expected. The lower horizons of the Live Oak orebody are soft and pack readily after being undercut, making the drawing of ore difficult and irregular, resulting in a lower grade of ore. At the end of the year modifications in the mining method were made, which it is hoped will improve the tonnage and grade.

Income Account Year Ended Dec. 31, 1925

Sales of copper			$11,497,356.85
Expenses			
Mining, including development	$4,072,801.05		
Reduction, including transportation of ore	3,672,292.35		
Refining and selling, including transportation of metals	1,738,543.85		
Administration and federal taxes	258,446.26		
Copper on hand at beginning of year	2,360,491.81		
	$12,102,575.32		
Less, copper on hand at end of year	2,628,090.56		9,474,484.76
			$2,022,872.09
Depreciation on buildings and equipment			368,749.44
			$1,654,122.65
Interest paid			16,787.15
			$1,637,335.50
Income from investments			179,465.72
Balance, net income of the year, carried to balance sheet			$1,816,801.22

Current assets as of Dec. 31 were $4,079,150, compared with liabilities of $1,940,199.

Bunker Hill & Sullivan Had Best Year in 1925

The Bunker Hill & Sullivan Mining & Concentrating Co., of Kellogg, Idaho, produced 37,974 tons of lead and 1,361,882 oz. of silver in 1925, which sold for $7,766,169.74, and, after deducting $4,334,940.26 in costs, left a profit of $3,431,229.48. Dividends paid amounted to $2,959,209.78. The profit-and-loss statement for 1925 shows an operating surplus, after depletion, of $3,459,813.91; normal surplus was increased from $8,855,587.84 as of Dec. 31, 1924, to $9,841,809.90 as of Dec. 31, 1925. Stanly A. Easton, manager, states in the annual report that because of the larger output of mine-run ore and metallic lead during 1925, and the uniformly strong lead market throughout the entire year, a greater operating profit was made than for any former year in the history of the mine.

The Bunker Hill smelter produced more refined lead and silver than during any previous year. The receipts of custom ores were larger, and these continue to grow. The physical condition of the smelting plant is excellent.

Crosscutting from the No. 18, or bottom, level of the Bunker Hill mine, has disclosed the principal oreshoot, which is now being actively developed. Ore blocked out to date in the Sullivan mine is 53,619 tons; and in the Bunker Hill mine 3,781,795 tons, making a total of 3,835,414 tons.

Ray Consolidated 1925 Earnings, $3,438,523

Earnings of the Ray Consolidated Copper Co., from its operations at Ray, Ariz., and Santa Rita, N. M., totaled $3,438,523 during 1925. The following data are from the current annual report:

Estimated Future Production

	Tons	Copper: Per Cent
Ray mines	89,860,223	1.68
Chino mines, including stockpile	105,242,094	1.44
Total	195,102,317	1.55

Total gross production of the Ray mines from all sources for the year was 77,472,911 lb. compared to 69,590,391 lb. for the year 1924. The net production for the year from all sources, after allowances for smelter deductions, was 74,691,091 lb., compared to 67,017,981 lb. for 1924. From the Chino mines the total production of copper was 70,218,343 lb., which, after allowing for smelter tolls, made the net output of refined copper 67,385,620 lb.

The average cost of net copper produced in marketable form was 10.84c. per pound, including all operating costs, fixed and general expenses, and local taxes and before charges for depreciation of plant and equipment, but after reducing same by credit for the value of gold and silver recovered and for miscellaneous earnings from sources directly pertaining to operations.

Statement of Operations for the Year Ended Dec. 31, 1925

Operating revenue		
Copper produced—142,076,711 lb. @ 14.075c.	$19,997,848.94	
Gold produced — 5,054.7655 oz. @ $20....	101,095.31	
Silver produced — 4,116.06 oz. @ 70.3c...	2,895.47	
		$20,101,839.72
Operating expenses		
Mining, including stripping and mine development expense	$6,216,944.68	
Ore delivery—mine to mill	906,286.67	
Milling	4,198,532.35	
Treatment, freight and refining	4,183,602.73	
Selling expense	177,588.50	15,682,954.93
Profit from operations		$4,418,884.79
Miscellaneous income		215,463.37
Total income		$4,634,348.16
Charges against income		
Depreciation	$914,096.64	
Loss on property retired, etc	281,728.06	1,195,824.70
Net income to surplus account		$3,438,523.46

Surplus from Operations

Balance—Dec. 31, 1924	$13,478,177.45
Net income for year (without deduction for depletion)—as above	3,438,523.46
	$16,916,700.91
Charges against surplus	
Additional federal income tax for 1918 and adjustments of surplus in connection therewith	1,043,503.17
Balance—Dec. 31, 1925	$15,873,197.74

Shattuck Denn Mining Corporation

The following figures show the results of operations of the Shattuck Arizona Copper Co. for the first ten months, and of the Shattuck Denn company, after the absorption of the Denn company, for the last two months of 1925.

	Ten Months	Two Months
Gross operating income	$762,948	$189,951
Other income	34,093	4,521
Total income	$797,041	$194,472
Expenses	724,820	160,202
Depletion and depreciation	71,430	20,419
Net profit	$791	$13,851
Consolidation expense		37,967
Deficit		$24,116

Sources of Antimony Consumed in the United States

The American Bureau of Metal Statistics has summarized the domestic supply of antimony. The United States gets antimony in several forms, especially as antimonial lead produced by silver-lead smelters within the country, as antimonial lead imported and as metallic antimony or regulus, imported chiefly from China. No antimony regulus worth mentioning is produced in the United States.

Antimonial lead imported has been in the main old munition material, and since 1922 the introduction of this has been relatively small.

Domestic production of antimony from secondary material represents the reworking of old alloys, battery sludges and sundry mixtures. Reproduction of this antimony is largely in the form of alloys.

The antimony content of the antimonial lead that is produced in this country, and also that of what is imported, is widely variable. Formerly there was a good deal of uniformity in this product, but in recent years, owing to improvements of metallurgical methods, the refiner has become able to produce antimonial lead of high antimony content or low, according to the requirements of his customers. Consequently, it is no longer possible to generalize in respect of this matter so well as formerly.

Supply of Antimony for the United States

In Tons of 2,000 Pounds

	1920	1921	1922	1923	1924	1925
Smelter production of antimonial lead (antimony content) (a)	2,033	1,589	1,441	2,170	2,763	*3,060
Imports of antimony metal (b)	12,474	10,576	8,871	7,813	7,276	10,659
Imports in antimonial lead (a)	2,063	4,321	5,476	*211	*1,225	850
Production of secondary antimony (a) (c)	5,600	4,729	7,090	8,021	9,404	*9,000
Totals	22,170	21,026	22,878	18,215	20,668	23,569

(a) As reported by U. S. Geological Survey and U. S. Bureau of Mines, except as to figures indicated by asterisk, which are conjectural. (b) As reported by Bureau of Foreign and Domestic Commerce. (c) Including the antimony content of alloys.

Record Consumption of Copper

Estimates made by the American Bureau of Metal Statistics for consumption of copper in 1924 and 1925 are shown below in metric tons.

	1924	1925
United States	686,400	738,300
Canada	15,400	11,500
Total North America	701,800	749,800
Austria	13,900	17,000
Belgium	11,100	10,600
Czechoslovakia	12,300	15,700
France	132,300	121,600
Germany	131,600	232,700
Great Britain	135,900	137,100
Italy	52,900	63,500
Russia (a)	11,000	12,000
Spain	6,500	9,100
Sweden	18,100	18,000
Other Europe	27,500	25,000
Total Europe	553,000	662,300
Japan	63,500	67,900
Other Asia (a)	31,600	10,000
Total Asia	95,100	77,900
Africa (a)	12,000	12,000
Australia	9,700	9,000
Total world's consumption	1,371,600	1,511,000
World's production	13,73,600	1,440,300

(a) Metallgesellschaft for 1924.

Current Prices of Mining Supplies

Rise and Fall of the Market

STEEL prices will probably hold at present levels for another two months. Minimum on steel plates is 10c. per 100 lb. higher than a month ago at Pittsburgh mills. On the Pacific coast c.-i. pipe and track bolts are firmer, while there is apparent easing off in black steel sheets. Steel pipe discounts have increased four points during the past week at Chicago warehouses. Hose and flotation oils are higher. There is lack of firmness in pine lumber prices throughout New York State, the Middle West and the Gulf region.

SHEETS—Quotations are per 100 lb. in various cities from warehouse also the base quotations from mill:

Blue Annealed	Pittsburgh, Large Mill Lots	St. Louis	Chicago	San Francisco	New York
No. 10	$2.50	$3.60	$3.50	$3.75	$3.89
Black					
No. 28	3.25@3.35	4.60	4.10	4.75	4.50
Galvanized					
No. 28	4.60	5.70	5.25	6.00	5.65

STEEL RAILS—The following quotations are per ton f.o.b. Pittsburgh and Chicago for carload or larger lots:

	Pittsburgh Current	Pittsburgh One Year Ago	Birmingham	Chicago
Standard bessemer rails	$43.00	$43.00	$43.00	$43.00
Standard openhearth rails	43.00	43.00	43.00	43.00

TRACK SUPPLIES—The following prices are base per 100 lb. f.o.b. Pittsburgh for carload lots, together with the warehouse prices at the places named:

	Pittsburgh Current	Pittsburgh One Year Ago	Chicago	St. Louis	San Francisco	Birmingham
Standard spikes, ⅜-in. and larger	$2.80	$2.90	$3.55	$3.65	$4.35	$3.00
Track bolts	3.90@4.15	3.90@4.25	4.55	4.00	5.85	3.90
Standard section angle bars	2.75	2.75	3.40	3.25@3.75	4.00	4.15

STRUCTURAL MATERIAL—Following are base prices f.o.b. mill, Pittsburgh and Birmingham together with quotations per 100 lb. from warehouses at places named:

	Pittsburgh, Mill	Birmingham Mill	New York	Dallas	St. Louis	Chicago	San Francisco
Beams, 3 to 15 in.	$1.90@2.00	$2.05	$3.34	$4.15	$3.25	$3.10	$3.30
Channel, 3 to 15 in.	1.90@2.00	2.10	3.34	4.15	3.25	3.10	3.30
Angles, 3 to 6 in., ¼ in. thick	1.90@2.00	2.10	3.34	4.15	3.25	3.10	3.30
Tees, 3 in. and larger	1.90@2.00	2.10	3.34	4.15	3.35	3.10	3.30
Plates	1.90	2.00	3.34	4.15	3.25	3.10	3.30

WIRE ROPE—Discounts from list price, f.o.b. New York and east of Missouri River, on regular grades of bright and galvanized are as follows:

Cast steel round strand rope	20%
Galvanized steel rigging and guy rope	7½%
Round strand iron and iron tiller	5%
Plow steel round strand rope	35%
Special steel round strand rope	30%
Galvanized iron rigging and guy rope	+12½%

	New York	Cleveland	Chicago
Drill Rod (from list)	60@65%	55%	50%

WROUGHT PIPE—The following discounts are to jobbers for carload lots at Pittsburgh mill:

	Steel Inches	Steel Black	Steel Galv.	Iron Inches	Iron Black	Iron Galv.
BUTT WELD	⅛ to 3	62	50½	1 to 1½	30	13
LAP WELD	2½ to 6	59	47½	3 to 6	28	13

STEEL PIPE—From warehouses at the places named the following discounts hold for steel pipe:

	Black New York	Black Chicago	Black St. Louis
2½ to 6 in. lap welded	48%	55%	46%

CAST-IRON PIPE—The following are prices per net ton for carload lots:

	New York Current	New York One Year Ago	Birmingham	Chicago	St. Louis	San Francisco
6 in. and over	$50.60@52.60	$52.60@53.60	$41.00 @ 42.00 base	$49.20@50.20	$47.60	$52.00

NUTS—Semi-finished, ½x½-in., 2c. each. Discount 70% for ⅜-in. and smaller; 65% for ½-in. and larger. Case hardened, 6c. each, less 50%.

HOLLOW TILE—Price per block in carload lots to contractor for hollow building tile.

	New York Current on Trucks	New York One Year Ago	Chicago	Philadelphia	St. Louis	San Francisco	Perth Amboy N. J., Factory
4x12x12	$0.1112	$0.1162	$0.075	$0.12	$0.07	$0.108	.....
6x12x12	.1667	.1743	.096	.....	.094	.156	$0.252*
8x12x12	.2084	.2179	.135	.22	.128	.244	.312†

* 10x12x12; † 12x12x12.

MACHINE BOLTS—½x1½-in., per 100, $1.70. Discount at New York warehouses on all sizes up to 1x30-in., 40%.

LUMBER—Prices of rough Douglas Fir No. 1 common, in carload lots to dealers at yards in San Francisco. To contractors, $2 per M. ft. additional.

	6-8 and 12 Ft.	10-16-18 and 20 Ft.	22 and 24 Ft.	25 to 32 Ft
3x3 and 4	$26.00	$27.00	$28.00	$31.00
3x6 and 8	26.00	27.00	28.00	31.00
4x4-6 and 8	26.00	27.00	28.00	31.00

Wholesale prices to dealers of long leaf yellow pine. To contractors in New York City, delivered from lighters or cars to job, $5 additional.

	New York 20 Ft. and Under	New York 22-24 Ft.	Chicago Up to 20 Ft., Pine	Chicago Up to 32 Ft., Fir
3x4 to 8x8	$43.00	$44.00	$42.50	$41.00
3x10 to 10x10	50.00	51.00	47.50	41.00
3x12 to 12x12	57.00	58.00	57.50	41.00

Other Cities	8 x8-In. x 20 Ft. and Under Pine	Fir*	Hemlock	Spruce	12 x 12-In 20 Ft. and Under Pine	Fir*
Boston	$51.00	$48.50†	$51.00	$50.50	$61.00	$58.50†
Cincinnati	37.00	73.00	73.00	85.00	48.00	77.00
Denver	.....	34.75	34.75	34.75	.....	34.75
Minneapolis	42.00	37.75	35.00	.....	44.00	37.75
Kansas City, Mo.	29.00	20.00	.....	.....	44.00	21.00
Philadelphia	54.00	36.00	38.00	45.00	65.00	36.00

*Douglas fir. † Prime.

NAILS—The following quotations are per keg from warehouse:

	Pittsburgh, Mill	Chicago	San Francisco	Dallas	St. Louis	Montreal
Wire	$2.65	$3.05	$3.75	$4.28	$2.93	$4.95
Cut	2.80	.....	5.00	5.00	3.15	5.00

PORTLAND CEMENT—Prices to contractors per bbl. in carload lots *without bags*. Cash discount not deducted.

	Current	One Month Ago	One Year Ago
NewYork, del. by truck	$2.50@2.60	$2.50	$2.50@2.60
Chicago, f.o.b.	2.10	2.10	2.20
Cleveland, f.o.b.	2.29	2.29	2.39

LIME—Warehouse prices:

	Hydrated, per Ton Finishing	Hydrated, per Ton Common	Lump, per Barrel Finishing	280-lb.net Common
New York	$18.20	$12.@13.10	$3.50	$2.25@$2.75
Chicago	20.00	18.00	....	2.25

LINSEED OIL—These prices are per gallon:

	New York Currant	New York One Year Ago	Chicago Current	Chicago One Year Ago
Raw in barrel (5 bbl. lots)	$0.83½	$1.14	$0.85	$1.25

WHITE AND RED LEAD—In 100-lb. kegs, base price in cents per pound:

	Dry Current	Dry 1 Yr. Ago	In Oil Current	In Oil 1 Yr. Ago
Red	15.25	16.25	16.75	17.75
White	15.25	16.25	15.25	16.25

HOSE—Quotations at New York warehouses:

Fire Protection: Underwriters' 2½-in. coupled, single jacket (net) ..... 74c per ft.

Air—Best Grade: ½-in., per ft. ..... 3 ply $0.37½ 4 ply $0.46

Steam—Discounts from List: First grade ..... 30–10% Second grade ..... 40% Third grade 40–10%

RUBBER BELTING—List price 6-in., 6 ply, $1.83 per lin.ft. for rubber transmission belting.

Best grade ..... 50% Second grade 50–10%

LEATHER BELTING—List price, 24c. per lin.ft. per inch of width for single ply at New York warehouses:

Grade	Discount from list
Medium	40–5%
Heavy	30–10%

RAWHIDE LACING—For cut, best grade, 50%, 2nd grade, 60%. For laces in sides, best, 41c. per sq.ft.; 2nd, 37c. Semi-tanned: cut, 50%; sides, 41c. per sq.ft.

PACKING—Prices per pound:

Rubber and duck for low-pressure steam, ½ in.	$1.05
Rubber sheet	.60
Rubber sheet, wire insertion	.85

MANILA ROPE—Per lb., ¾-in. and larger, 1,200-ft. coils.

Atlanta	$0.27	New Orleans	$0.25½
New York	.27	Seattle	.24
Chicago	.25½	San Francisco	.25

EXPLOSIVES—Prices per pound of dynamite in small lots:

	Gelatin 40%	Gelatin 60%
New York	$0.26½	$0.2875
Minneapolis	.1917	.2123
Denver	.2025	.2275
Seattle	.165	.19
Cincinnati	.22	.245
New Orleans	.233	.26
San Francisco	.1625	.1925

FLOTATION OIL—

Pine tar, 50 gal. bbl., gross weight 500 lb., f.o.b. New York, carload lots, per gal. $0.45

CHEMICALS—

Zinc dust, 550 lb. casks, f.o.b. works, per lb.	$0.09@.10
Litharge, f.o.b. New York, kegs, per 100 lb.	15.25
Sodium cyanide, 220 lb. single case lots, f.o.b. works, per lb.	18@.22
Calcium carbide, in drums, f.o.b. works, per lb.	05½@.06

Mining Stocks—Week Ended April 17, 1926

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Anaconda	New York	43⅛	42	42⅜	Ap.17, My.24	0.75
Arcadian Consol.	Boston	*55	*30	*35		
Ariz. Com'l	Boston	10	9½	10	Jy.21, Jy. 31 SA	0.50
Calaveras	N. Y. Curb			2⅛		
Calumet & Arizona	New York	57⅞	56½	57⅝	Mr.5, Mr.21 QX	1.50
Calumet & Hecla	Boston	15⅝	14⅛	14⅜	Nov.30, De.15 Q	0.50
Cerro de Pasco	New York	62	60⅝	61⅛	Ap. 15, My. 1, Q	1.00
Chile Copper	New York	32⅛	32	32⅛	Ma.3, Ma.29, Q	0.62½
Chino	New York	21	20	20⅛	Sept., 1920	0.37½
Con. Coppermines	N. Y. Curb	1⅛	1⅛	1⅛		
Copper Range	Boston	16½	15	15½	May, 1925	1.00
Crystal Copper	Boston Curb	*39	*34	*38		
East Butte	Boston	3½	3½	3½	Dec., 1919	0.50
First National	Boston Curb	*15	*13	*13	Feb., 1919	0.15
Franklin	Boston	*50	*50	*50		
Granby Consol	New York	19½	17⅛	19	May, 1919	1.25
Greene-Cananea	New York	10⅛	9¼	10⅛	Nov., 1920	0.50
Hancock	Boston			*80		
Howe Sound	New York	33⅛	31½	31½	Ap.1, Ap.15	0.75
Inspiration Consl.	New York			22⅛	Mar.18, Ap.5, Q	0.50
Iron Cap	Boston Curb	3⅜	3⅛	3⅛	May, 1923	0.15
Isle Royale	Boston	12⅜	10	10⅛	No.30, De.5	1.00
Jerome Verde Dev	N. Y. Curb	*95	*95	*95		
Kennecott	New York	52	50⅛	52	Ma.5, Ap.15 Q	1.00
Lake Copper	Boston	1	1	1	June, 1925	0.50
Magma Copper	New York	37⅛	35	35	Mh.31, Ap.15, Q	0.75
Mason Valley	N. Y. Curb	2	1⅞	1⅞		
Mass Consolidated	Boston	*35	*25	*26	Nov., 1917	1.00
Miami Copper	New York	12⅛	11⅞	12	My.1, My.15 Q	0.25
Mohawk	Boston	32	30	31	My.1, Je.1 Q	1.00
Mother Lode Coa	New York	6⅛	6⅛	6⅛	De. 11, De. 31	0.37½
Nevada Consol	New York	12⅞	12⅛	12⅜	Mh.18, Mh.31 Q	0.25
New Cornelia	Boston	20⅜	19⅜	20⅛	My.7, M.24 Q	0.40
North Butte	Boston	2 7/16	2	2 7/16	Oct., 1918	0.25
Ohio Copper	N. Y. Curb	*53	*50	*50	No. 14, De. 2	0.05
Old Dominion	Boston	16	15⅛	16	Dec., 1918	1.00
Phelps Dodge	Open Mar.	†130	†120		Mar.20, Apr.20 Q	1.00
Quincy	Boston	20	18⅛	19	Mar., 1920	1.00
Ray Consolidated	New York	12⅛	12½	12⅛	Ap.20, Ap.30	0.25
Ray Hercules	N. Y. Curb			11⅛		
St. Mary's Min. Ld.	Boston	30	28	28½	Ap.17, My.18	2.00
Seneca Copper	New York	6	6	6		
Shannon	Boston			*50	Nov., 1917	0.25
Superior & Boston	Boston	*60	*50	*50		
Tenn. C. & C.	New York	12	11¼	11⅛	Fe.27, Ma.15, Q	0.25
United Verde Ex	N. Y. Curb	27⅛	27	27⅛	Ap.6, My.1,	0.75
Utah Copper	New York			93	Mh.18, Mh.31, Q	1.25
Utah Metal & T	Boston	2⅛	1⅞	2	Dec., 1917	0.30
Victoria	Boston			*50		
Walker Mining	Salt Lake	*97	*90	*94		
NICKEL-COPPER						
Internat. Nickel	New York	35	33⅜	34⅛	My.11, My.31, Q	0.50
Internat. Nickel, pfd.	New York			103	Ap.15, My.1, Q	1.50
LEAD						
Gladstone M. M. Co.	Spokane	*35	*29½	*29½	Ja. 1, Ja. 10 M	0.01½
National Lead	New York	144½	138	140	Ma.12, Ma.31 Q	2.00
National Lead pfd	New York	117⅞	117⅜	117⅞	My.21, Je.15 Q	1.75
St. Joseph Lead	New York	39⅛	37⅜	38⅛	Je.10, Je. 21 QX	0.75
ZINC						
Am. Z. L. & S	New York	7⅛	7⅛	7⅛	May., 1920	1.00
Am. Z. L. & S, pfd	New York	30	28⅛	30	Nov., 1920	1.50
Butte C. & Z	New York	5	4⅞	4⅞	De.10, De.24	0.50
Butte & Superior	New York	12⅜	12⅛	12⅛	Ma.15, Ma.31 Q	0.50
Callahan Zn-Ld	New York	1⅜	1⅛	1⅛	Dec., 1920	0.50
Eagle Picher	Cincinnati	29⅛	28⅛	28⅛	My. 15, Jn. 1	0.40
Eagle Picher, pfd	Cincinnati			110	Mh.31, Ap.15 Q	1.50
New Jersey Zn	N. Y. Curb			208	Ap.2u, My.10 Q	2.00
United Zinc	N. Y. Curb			*70		
Yellow Pine	Los Angeles	*22½	*22½	*22½	De.8, De.18 Q	0.04
GOLD						
Alaska Juneau	New York	1⅛	1⅛	1⅛		
Argonaut	Toronto	*30⅝	*26½	*27		
Barry-Hollinger	Toronto	*40	*38½	*39		
Carson Hill	Boston			*30		
Consol. W. Dome L.	Toronto	*21⅛	*18	*18		
Cresson Consol. G.	N. Y. Curb			2½	Mh.31, Ap.10	0.10
Crown Reserve	Toronto	*16½	*13	*14	Jan., 1917	0.05
Dome Mines	New York	16	13	14½	Mh.31, Ap.20, Q	0.50
Golden Center	N. Y. Curb	1⅛	1⅛	1⅛		
Golden Cycle	Colo. Springs	†1.51½	†1.50½		No. 30, Dec. 10 Q	0.03
Hollinger Consol	Toronto	18.30	18.05	18.05	Ap. 6, Ap.22,	0.08
Homestake Mining	New York			54	Ap.20, Ap.26 M	0.50
Kirkland Lake	Toronto	1.26	1.13	1.23		
Lake Shore	Toronto	10.30	9.95	10.00	Ma.1, Ma.15 Q	0.10
McIntyre-Porcupine	New York	25⅛	24⅛	25	My.1, Je.1	0.05
Newray	Toronto	*37⅛	*37¼	*37½		
Night Hawk Pen	Toronto	*6⅛	*6	*6		
Noranda	N. Y. Curb	15⅞	14⅛	15⅛		
Portland	Colo. Springs	†*56	†*50		Apr.6, Apr.15	0.02
Rand Mines	New York			34⅜	Fe.16, Fe.26	1.52
Teck-Hughes	Toronto	3.42	3.15	3.22	Ja. 15, Fe. 1	0.05
Tom Reed	Los Angeles	*72⅛	*72⅛	*72⅛	Ma.10 Ma.20	0.02
Tough-Oakes	Toronto	*45⅛	*36	*36		
United Eastern	N. Y. Curb	*40	*40	*40	July, 1924	0.05
Vipond Cons	Toronto	1.73	1.59	1.61		
Wright-Hargreaves	Toronto	8.00	7.90	8.00	Mh.15, Ap.15 QX	0.07½
Yukon-Alaska Trust	N. Y. Curb			21½		
GOLD AND SILVER						
Carnegie Metals	Pittsburgh	17⅛	17	17		
Con. Cortez	N. Y. Curb			*6		
Con. Virginia	San Francisco	*13⅛	*11	*11⅛		
Continental Mines	N. Y. Curb			*45		
Dolores Esperansa	N. Y. Curb			*50	July, 1923	0.05
Premier Gold	N. Y. Curb	2⅛	2⅛	2 3/16	Mh.19, Apr.3 Q	0.08
Tonopah Belmont	N. Y. Curb	3⅛	3	3	Se.15, Oc.1	0.05
Tonopah Extension	N. Y. Curb	*61	*51	*55	Apr. 1925	0.05
Tonopah Mining	N. Y. Curb	5⅛	5⅛	5⅛	Ap.7, Ap.21 Q	0.07½
Unity Gold	N. Y. Curb			*20		
West End Consol	N. Y. Curb			*25	Mar., 1923	0.05
Yukon Gold	N. Y. Curb			*45	June, 1918	0.02

Stock	Exch.	High	Low	Last		Last Div
SILVER						
Alvarado	N. Y. Curb			1	Oct., 1920	0.50
Beaver Consol	Toronto	*83½	*73	*81	May. 1920	0.03
Castle-Trethewey	Toronto	1.61	1.50	1.53		
Coniagas	Toronto	3.85	3.85	3.85	May, 1924	0.12½
Keeley	Toronto	1.67	1.61	1.65	Ma.1, Ma.15 X	0.12
Kerr Lake	N. Y. Curb	1	1	1	Ap.1, Ap.15	0.12½
La Rose	Toronto	*17	*12	*13	Apr., 1922	0.10½
Lorrain Trout Lake	Toronto			*85	Jy. 2, Jy. 15	0.05
McKinley-Dar.-Sav	Toronto	*17	*15½	*16	Oct., 1920	0.03
Mining Corp. Can	Toronto	3.68	3.45	3.67	Ja. 16, Ja.30	0.12½
Nipissing	N. Y. Curb	6	5⅛	5⅛	Mh.31, Ap.20, Q	0.15
Temiskaming	Toronto	*13	*12½	*12½	Jan., 1920	0.40
SILVER-LEAD						
Ahumada	New York	8⅞	8½	8⅝	Mh.8, Ap.5, Q X	0.25
Alta Merger	Salt Lake	†*3½	†*2			
Bingham Mines	Boston	41	38	38	Ma.20, Ma.31 Q	1.00
Cardiff M. & M	Salt Lake			*55	De.16, No.18	0.10
Chief Consol	Salt Lake	3.10	3.10	3.10	Fe. 1,	0.10
Emma Silver	Salt Lake	†1	†*50			
Erupcion	Boston Curb	1⅞	1⅞	1⅞	Mh.18, Ap.5, X	0.10
Federal M. & S	New York			86		
Federal M. & S., pfd.	New York	73	71	72	No.25, De.15 Q	1.75
Hawthorne Mines	N. Y. Curb	*20	*16	*16		
Hecla Mining	N. Y. Curb	17⅛	17⅛	17⅛	My.15, Je.15 Q	0.50
Iron King Mining	Salt Lake			34		
Keystone Mining	Salt Lake	*47	*45	*47	Au.12, Au.26	0.07½
Lucky Jim	Spokane	*16½	*16	*16		
Mammoth Mining	Salt Lake	2.80	2.75	2.75	Mar.24, Apr. 1	0.10
Marsh Mines	Spokane	*4⅜	*4	*4	Se.15, Oc.1	0.15
Ontario Silver	New York			10		
Park Utah	Salt Lake	6.60	6.25	6.25	Mh.15, Ap.1	0.15
Prince Cons	Salt Lake			*4⅛		
Silver King Coal	Salt Lake	7.50	7.05	7.30	Mh.20, Ap.1, Q	0.25
Silversmith	Spokane	*48	*46½	*47⅛	Apr. 1, Apr.10	0.02
Tamarack-Custer	Spokane	*51	*44	*51	Sept., 1924	0.25
Tintic Standard	Salt Lake	12.00	11.75	11.75	Mh.1, Mh.20, QX	0.40
Utah-Apex	Boston	8⅞	7⅞	8	Apr. 9, Apr. 15	0.25
Western Utah Copper	N. Y. Curb			*8		
IRON						
Bethlehem Steel	New York	40½	38½	31½	July, 1924	1.25
Colorado Fuel & Iron	New York	32⅛	28⅛	31⅛	May, 1921	0.75
Gt. North'n Iron Ore	New York	22⅛	22⅛	22⅛	De. 4, De. 28,	0.75
Inland Steel	New York	38	37½	37⅞	Fe.15, Ma.1 Q	0.62½
Mesabi Iron	N. Y. Curb	1⅞	1⅞	1⅞		
Replogle Steel	New York	10	9	9⅛		
Republic I. & S	New York	49⅛	47½	48½	May, 1921	1.50
Republic I. & S. pfd.	New York	93	92⅛	93	Ma.15, Ap.1, Q	1.75
Sloss-Sheffield S. & I.	New York	110	103	107½	Ma.10, Ma.20 Q	1.50
Sloss-Shef. S.&I. pfd.	New York	103½	103⅛	103½	Ma.20, Ap.1, Q	1.75
U. S. Steel	New York	120½	117	118⅛	Fe.27, Ma.3 X	Q 1.75
U. S. Steel pfd	New York	127	126⅛	126⅜	Fe. 3, Fe. 27, Q	1.75
Virginia I. C. & C	New York	47⅛	47	47⅛	Jan., 1924	1.50
Virginia I.C.&C.pfd	New York			73⅛	De.15, Ja.2,	2.50
ALUMINUM						
Alum. Co. of Amer	Open Market			65		
Alum. Co. of Amer. pfd.				†199⅛		
VANADIUM						
Vanadium Corp.	New York	37⅛	34⅛	36	Fe.1, Fe.15, Q	0.50
ASBESTOS						
Asbestos Corp.	Montreal	97	95	96½	De.31, Ja.15 Q	1.50
Asbestos Corp., pfd.	Montreal	120	118	119	De.31, Ja.15, Q	1.50
SULPHUR						
Freeport Texas	New York	26⅛	22⅛	25⅜	Nov., 1919	1.00
Texas Gulf	New York	132⅜	128	130	Ma.1, Ma.15, Q	2.50
DIAMONDS						
De Beers Consol	New York	27⅞	27⅜	27⅞	Ja.26, Fe.2	0.23
PLATINUM						
So. Am. Gold & P	N. Y. Curb	4	4	4		
MINING, SMELTING, REFINING AND GENERAL						
Amer. Metal	New York	50⅛	49½	50	Fe.18, Ma.1, Q	1.00
Amer. Metal pfd	New York	113⅛	113⅛	113⅛	Fe. 19, Ma. 1, Q	1.75
Amer. Sm. & Ref.	New York	118	112⅞	112⅞	Ap.16, My.1, Q	1.75
Amer. Sm.&Ref.pfd.	New York	114⅞	114	114⅛	My.7, Je.1, Q	1.75
Consol. M. & S	N. Y. Curb			208	De.31, Ja.15	0.75
Federated Metals	N. Y. Curb	17	15	17		
Newmont Mining	N. Y. Curb	49⅛	44⅛	49½	Mar.31, Apr.15,	0.60
Southwest Metals	N. Y. Curb			2		
U. S. Sm. R. & M	New York	41⅛	38⅛	39	Ap.8, Ap.15, Q	0.87½
U. S. Sm. R.&M.pfd.	New York	48	47⅞	47⅞	Ap.8, Ap.15, Q	0.87½

* Cents per share. † Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. K, Irregular. I, Initial. X, Includes extra. The first date given is that of the closing of the books; the second that of the payment of the dividend.

Boston quotations courtesy Boston Stock Exchange; Toronto quotations those of the Standard Stock Exchange of Toronto, by courtesy of Arthur E. Moysey & Co.; Spokane, Pohlman Investment Co.; Salt Lake, Stock and Mining Exchange; Henry Sachs, Colorado Springs, Colo.

PRICE WEEK ENDED APRIL 6th, 1926

Name	High	Low	Last	Last Dividend Date	Amount
Aramayo Mines (25 frs.)	82/6	78/1½	80/—	Feb. 1926	5 p.c.†
British Platinum (£1)	7/6	6/1½	7/6	Feb. 1925	2½ p.c.
Burma Corpn. (10 rupees)	16/1½	15/6	15/9	Feb. 1926	6 annas*
Bwana M'Kubwa (5s)	6/7½	6/1½	6/7½		
Camp Bird (£1)	5/3	5/1½	5/3		
El Oro (£1)	6/7½	6/3	6/6	Nov. 1924	2½ p.c.*
Esperanza (10s)	1/6	1/3	1/6		
Frontino & Bolivia (£1)	8/6	8/3	8/6	Jan. 1926	1½ p.c.
Mexican Corpn. (£1)	19/—	18/3	18/6		
Mexico Mines of El Oro (£1)	31/3	30/—	30/—	Dec. 1925	12½ p.c.*
Oroville Dredging (£1)	3/9	3/6	3/9	Dec. 1923	3½ p.c.
Ouro Preto (£1)	2/6	2/—	2/6	May 1925	2½ p.c.
Rhodesian Congo Border	113/—	108/9	112/6		
St. John del Rey (£1)	7/9	6/9	7/6	June 1925	6½ p.c.
San Francisco Mines (10s)	29/—	28/3	28/9	Jan. 1926	22½ p.c.
Santa Gertrudis (£1)	20/9	20/3	20/6	July 1920	5 p.c.
Selukwe (2s. 6d.)	11/6	10/1½	11/—	April 1917	6¼ p.c.
S. Amer. Copper (2s.)	5/1½	4/9	5/—	Nov. 1917	75 p.c.
Tanganyika (£1)	42/9	37/6	40/—	Sept. 1925	5 p.c.
Tomboy (£1)	3/1½	3/—	3/—	Jan. 1926	5 p.c.
Union Miniere du Haut-Katanga (Brussels)	6.000	5.500	5.600	July 1925	150 frs.‡

* Free of British income tax. † Swiss frs. ‡ Belgian frs.